SAM/IG/3

INTERNATIONAL CIVIL AVIATION ORGANIZATION

Second Workshop/Meeting of the SAM Implementation Group
Regional Project RLA/06/901

(SAM/IG/3)

FINAL REPORT

Lima, Peru, 20 to 24 April 2009

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HISTORY OF THE MEETING

ii-1 PLACE AND DURATION OF THE MEETING

The Third Workshop/Meeting of the SAM Implementation Group (SAM/IG/3) was held at the premises of the ICAO South American Regional Office in Lima, Peru, from 20 to 24 April 2009, under the auspices of Regional Project RLA/06/901.

ii-2 OPENING CEREMONY AND OTHER MATTERS

Mr. Jose Miguel Ceppi, Regional Director of the ICAO South American Office, greeted the participants and expressed his gratitude to DGCA Peru, for the continuous support provided to activities developed at regional scale by the South American Office, as well as to the civil aviation authorities and national and private organizations of the ICAO South American Region, as well as the FAA for the continuous support to the activities of the SAM Implementation Group. Finally, he pointed out the importance of issues to be dealt with in the agenda of the Third Workshop/Meeting, which will allow the review of the matters dealt with during the Second Workshop/Meeting SAM/IG/2, and emphasized that the teamwork shown by the Implementation Group is essential to execute the projects that have been adopted by the Region.

Mr. Eliseo Salcedo Mitrani, Director of Aviation Safety, on behalf of the General Director of Civil Aviation, welcomed the participants, highlighting the importance of the issues to be examined at regional level, opening the meeting.

ii-3 SCHEDULE, ORGANIZATION, WORKING METHODS, OFFICERS AND SECRETARIAT

The Meeting agreed to hold its sessions from 09:00 to 15:00 hours, with appropriate breaks. The work was done with the Meeting as a Single Committee, Working Groups and Ad-hoc Groups.

Mr. Miguel Angel Castillo Ochoa, delegate from Bolivia, served as Chairman of the Meeting and Mr. Guillermo R. Cocchi, delegate from Argentina, as Vice President.

Mr. Jorge Fernández, RO/ATM/SAR of ICAO Regional Office, Lima, acted as Secretary, assisted by Messrs. Onofrio Smarrelli, RO/CNS, Alberto Orero, RO/ATM/SAR/AIM, from the Lima Office, and the Project RLA/99/901 experts. Likewise, the Secretariat had the support of the Implementation Groups Rapporteurs and Coordinator, to analyze de different agenda items.

ii-4 WORKING LANGUAGES

The working language of the Meeting was Spanish, with simultaneous interpretation in English, and its relevant documentation was presented in Spanish and English.

ii-5 **AGENDA**

The following agenda was adopted:

Agenda Item 1: Monitoring to Conclusions and Decisions adopted by SAM/IG Meetings

Agenda Item 2: Optimization of the ATS routes structure

Agenda Item 3: Implementation of performance-based navigation (PBN) in the SAM Region

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

Agenda Item 5: Implementation of air traffic flow management (ATFM) in the SAM Region

Agenda Item 6: Assessment of operational requirements in order to determine the implementation of communications and surveillance (CNS) capabilities improvement for en-route and terminal area operations

Agenda Item 7: Operational implementation of new ATM automated systems and integration of the existing systems

Agenda Item 8: Other business

ii-6 **ATTENDANCE**

The meeting was attended by 56 participants from 11 States of the SAM Region Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Panamá, Paraguay, Perú, Uruguay and Venezuela, 1 State of NAM Region, United States, and 3 International Organizations, ARINC, IATA and IFATCA. The list of participants is shown in pages iii-1 to iii-10.

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Agenda Item 1: Monitoring to Conclusions and Decisions adopted by SAM/IG Meetings

Status of compliance of conclusions formulated by SAM/IG meetings and pending activities

1.1 During SAM/IG Meetings, some conclusions were formulated and a series of activities were adopted, oriented towards the implementation of different functions that will enable the Region to evolve towards the application of the global ATM operational concept.

1.2 As a consequence of the aforementioned, follow up actions are carried out by identifying the tasks to be performed and/or corresponding Conclusion in areas under analysis; the specific tasks that will lead to the accomplishment of the main task, what results are expected in each one of them, deadlines, responsible persons for their performance, support members for the task and, finally, the execution status of the same is identified, and when necessary, for a better understanding, some explanatory comment is included on the status of execution.

1.3 The SAM/IG/3 Meeting made a thorough analysis of each task identified and made comments on specific tasks resulting, evaluated, if it was necessary to modify the finalisation date, a well as the status of implementation of each specific task. The result of this evaluation is shown in **Appendix A** to this part of the report.

1.4 Also, the meeting assessed specific details under responsibility for execution by each State. The result is shown in **Appendix B** to this part of the report.

Result of the Second Coordination Meeting (RCC) of Project RLA/06/901

1.5 The meeting took note that the Second Meeting of the Coordination Committee of Project RLA/06/901 "*Assistance for the implementation of a Regional ATM System, taking into account the ATM Operational Concept and the support to CNS Technology*" was held at the ICAO South American Regional Office, on 2-3 December 2008.

1.6 The meeting was attended by 5 member States of the project and one non member State. The meeting reviewed the agreements reached at the First Coordination Meeting (RCC/1) and the report on the activities carried out during 2008. It also analysed the support provided by the States to the project, and the financial contributions made, taking note that the member States of the project were Argentina, Brazil, Bolivia, Chile, Paraguay, Panama, Peru, Uruguay, and Venezuela.

1.7 It could be noted that Project RLA/06/901 is receiving an important support from its member States, as reflected in the timely deposit of shared costs and the broad participation in its activities, whether at the meetings/workshops, courses, or through the secondment of State experts to perform specific tasks.

1.8 The work modality of the project is based on the efficient and transparent use of State resources, maximising regional capacity or generating such capacity where necessary. The project represents an important implementation and regional integration tool.

1.9 The Project Coordination Committee meeting is responsible for monitoring the proper utilisation of available resources and its results, approving work plans, analysing proposed amendments to the project document, and producing annual reports.

1.10 The meeting also agreed that Secretariat urge the States that have not yet joined the project to consider doing so.

APPENDIX A

LIST OF CONCLUSIONS AND/OR TASKS ORIGINATED IN SAM/IG MEETINGS

No.	Task to be developed	Specific tasks	Deliverables	Finalization date	Responsible	Supporting members to the task	Status of implementation
Activities identified during SAM/IG/1							
1-1	**SAM/IG/1-1 CAR/SAM PBN Roadmap** That ICAO SAM States, in implementing RNAV/RNP, take the pertinent actions to follow guidelines contained in the CAR/SAM PBN Roadmap as shown in Appendix C to this part of the report.	Shall facilitate implementation at a regional level Each State should comply with the actions agreed in the PBN Roadmap	States will have a National en-route, TMA and APP PBN implementation Plan.	SAM/IG/3	States	N/A	Valid
1-2	Hiring of PBN Experts in order to comply with the work programme shown in **Appendix A**	Shall facilitate implementation at a regional level. Prepare Terms of Reference. Determine expert profile Check work programme	The Region will count with the support of PBN Experts. A database will be available. Further tasks will be defined in PBN issues	**SAM/IG/2**	Secretariat SAM Project RLA/06/901		Completed SAM/IG/2 material developed was presented
1-3	Establish coordination mechanism between Projects RLA/99/01 and RLA/06/901 in order to direct PBN requirements from one Project to another.	Coordinate with administrators	Two regional projects will be oriented towards the requirements of SAM Region	Permanent while projects last	Secretariat SAM		A coordination mechanism was established

No.	Task to be developed	Specific tasks	Deliverables	Finalization date	Responsible	Supporting members to the task	Status of implementation
1-4	That States examine: a) Impact of RNAV routes implementation in t he airspace b) Aircraft fleet c) Air traffic services, and d) Establish pertinent coordination so as to enable integrated, harmonious and timely implementation of more direct RNAV routes.	Analyse airspace Evaluate national and international fleet Evaluate ATS Coordinate with authorities involved Coordinate with adjacent States, if necessary	Adequate information will be available to execute PBN action plan. A new ATS routes network will be available, based on RNAV with necessary PBN values, so as to respond to current requirements of airspace users	SAM/IG/4	PBN States Focal points	N/A	Valid The process of implementation of new RNAV routes continues (See Appendix B).
1-6	Establish policies in the use of restricted airspaces in a temporary basis or Permanent airspaces of special utilisation, which shall enable a flexible use of the airspace (FUA)	coordination with military authorities	FUA implementation Shall improve airspace structure	N/A	States		Action extended during SAM/IG/2 See activity 2-15 below.
1-7	Check information for RNAV routes implementation of **Appendix B** to Report on Agenda item 1, SAM/IG/2 Meeting.	Evaluate geographical coordinates of reporting points. Propose the Secretariat the changes deemed pertinent. Proceed to prepare the corresponding proposal for amendment.	* States involved Secretariat SAM	30 days as of 28 April finalizing on 28 May Tele-conferences agreed previously via email, will be used for coordination purposes	States		Superseded **See activity 2-1 and 2-2 below**

No.	Task to be developed	Specific tasks	Deliverables	Finalization date	Responsible	Supporting members to the task	Status of implementation
SAM/IG/2 **Agenda Item 1: Optimisation of ATS routes structure**							
2-1	Implementation of RNAV routes	Continue with the optimisation of ATS routes structure Identify the need and propose and coordinate with administrations involved the implementation, modification or elimination of RNAV routes	Implementation of routes shown in **Appendix A** SAM/IG/2	SAM/IG/3	RNAV routes States Focal points	Jorge Fernández/ Alberto Orero	Valid Coordination has been made with States to implement routes Lima/Madrid Guayaquil/ Madrid. Chile and Perú shall present the result of the evaluation for the implementation of route Santiago/Miami
2-2	Carry out a feasibility study to obtain a new ATS routes network that responds to the new requirements		Initial evaluation made to be presented at SAM/IG/3	SAM/IG/4	Expert Julio Pereira	Jorge Fernández/ Alberto Orero	Completed

No.	Task to be developed	Specific tasks	Deliverables	Finalization date	Responsible	Supporting members to the task	Status of implementation
Agenda Item 2: Implementation of performance-based navigation (PBN) in the SAM Region							
2-3	**Conclusion SAM/IG/2-1** **PBN implementation Programme for en-route operations** That the ICAO SAM States take appropriate actions to follow the guidelines and comply with the targets established in the PBN implementation for en-route operations, which is shown in **Appendix B** to this part of the Report.	Execution of the action plan	RNAV 5 Implemented in the SAM Region	SAM/IG/3	States PBN Focal points	Jorge Fernández	Valid. 11/2/09 A message was sent reminding the activities to be developed.
2-4	Inclusion of Traffic samples on ATS routes and pairs of cities in the ICAO SAM Office website	Include in the SAM Office website	Information available to States	December 2008	Secretariat	Silvia García/ Arturo Martínez	Completed In the SAM/IG/2 Report
2-5	Evaluate PBN implementation in ATC automated Systems, taking into consideration amendment 1 to PANS/ATM (FPLSG)	Analysis of proposal	Guidance to States provided	SAM/IG/5 Will become effective on 15 November 2012	Working Group created by GREPECAS	CNS/ATM Silvia García	Completed In charge of the GREPECAS ATM/CNS Subgroup
2-6	**Include amendment 1 to the PANS/ATM (FPLSG) in the SAM Office website** Reference AN 13/2.1-08/50 dated 25 June 2008	Include in the website	Information available to States	SAM/IG/2	Secretariat	Silvia García/ Arturo Martínez	Completed Incorporated in Appendix A to Agenda Item 5 of SAM/IG/1

No.	Task to be developed	Specific tasks	Deliverables	Finalization date	Responsible	Supporting members to the task	Status of implementation
2-7	Analyse the aircraft approval requirements and operators (pilots, dispatchers, and maintenance personnel), as established in PBN manual and develop necessary documentation. Note: See Agenda Item 3 of SAM/IG/2	Develop LAR in relation to PBN approvals	Guidelines available at States	SAM/IG/3 SAM/IG/4	Project RLA/99/901	Jorge Fernández/ Oscar Quesada/ Marcelo Ureña/ Verónica Chávez	Under development, responsible Project RLA/99/901 A work plan for the development of LARs has been established
2-8	Evaluate regulations for GNSS use, and if such were the case, proceed with the publication	Review available information	All SAM States with regulations for the use of GNSS available	SAM/IG/3	Secretariat	Onofrio Smarrelli/ Jorge Fernández	Completed
2-9	Include the documentation models on GNSS in the SAM Office website	Include in the SAM Office website	Information available to States	SAM/IG/3	Secretariat	Onofrio Smarrelli/ Silvia García/ Arturo Martínez	Valid
2-10	**Conclusion SAM/IG/2-2 Initial AIC** That States of ICAO SAM Region using as model the AIC presented in Appendix C to this part of the Report: a) publish in the AIRAC date of 9 April 2009 an Aeronautical Information Circular (AIC) informing the aeronautical community on their intention to implement RNAV 5 on 18 November 2010; b) reflect in this AIC the specific situations within the airspace under their jurisdiction.	Prepare and publish AIC in the date established	Timely distribution in time and model established on RNAV 5 implementation	9 April 2009	States Focal PBN Points	Jorge Fernández	Valid 11/2/09 A message was sent to States requesting them to publish the corresponding AIC
2-11	Include AIC model in the SAM Office website	Include in the website	Information available to States	December 2008	Secretariat	Silvia García/ Arturo Martínez	Completed/ Report published

No.	Task to be developed	Specific tasks	Deliverables	Finalization date	Responsible	Supporting members to the task	Status of implementation
2-12	**Conclusion SAM/IG/2-3** **Survey on the Fleet Navigation Capacity** That States conduct a survey on the fleet navigation capacity, using, to that end, the form contained in **Appendix D** to this part of the Report, and send the information collected to the ICAO South American Regional Office, on the following dates: a) Aircraft operating commercial flights, which have more than 5 700 kg. of MTOW – 15 February 2009; b) Aircraft operating commercial flights, which have less than 5 700 kg. of MTOW – 15 May 2009; c) Other aircraft registered in the Region – 15 August 2009. During the SAM/IG/3 the form of PBN capacity survey was modified, including a new box for RNP AR APCH operations, in view that the requirements for this approach are different to those for RNP APCH operations. At the SAM/IG/3 Meeting the survey form for PBN aircraft capacity was modified, including a new box for RNP AR APCH operations, in view that the requirements for this approach are different to those requirements for RNP APCH operations	States carry out a survey Secretariat upload SAM/IG/2 Report Form Agenda Item 2, Appendix D	Air Fleet Navigation Capacity in known SAM Region	The date was unified and re-programmed to deliver items a), b) and c) until 31 July 2009	Focal points assigned by States Secretariat SAM	Jorge Fernández/ Oscar Quesada/ Marcelo Ureña/ Verónica Chávez	**Valid** The status of implementation will be reviewed at the SAM/IG/3 by States. The initial date was modified for March 2009 LT 2/3A.5-SA 058 dated 29 January 2009 Survey was sent to States for its implementation Clarification of the survey was also sent. During the SAM/IG/3 Meeting the delivery date was changed to 31 July 2009.
2-13	Execute the tasks to be developed by Regional Project RLA/06/901 See SAM/IG/2 Report Table 2.16.1.	Hire an expert through Regional Project RLA/06/901	Tasks identified by Regional Project RLA/06/901 carried out	SAM/IG/4	Experts RLA/06/901	Jorge Fernández/ Oscar Quesada	Valid Under Development

No.	Task to be developed	Specific tasks	Deliverables	Finalization date	Responsible	Supporting members to the task	Status of implementation
	1.2 Collect air traffic data to understand air traffic flows in a specific airspace	States shall collect air traffic flow data	States will have a clear scope of the type of traffic operating in a specific airspace	SAM/IG/4	States PBN Focal Points	Jorge Fernández/ Alberto Orero	Under Development
	1.3 Analyse Aircraft fleet navigation capacity			SAM/IG/4	RLA/99/901	Verónica Chávez	Valid. Under development See task N° 2-12 above
	1.4 Analyse ground Communications, navigation and surveillance means (VOR, DME) to attend navigation specifications and reversal navigation mode			SAM/IG/4			Task CNS
	1.5 Optimise airspace structure, re-organising the network or implementing new routes base don strategic objectives of the airspace concept, taking into consideration “airspace modelling”, ATC simulations (accelerated and/or real time), live trials, etc.						Valid
	2.1 Prepare a performance measurement plan, including gas emissions, safety, efficiency, etc.	Verify available Tools to carry out this task Prepare a measuring plan	A measurement plan will be available to enable a clear vision on the current and future status of performance in gas emissions, safety and efficiency	SAM/IG/5	RLA/06/901	Jorge Fernández	Valid No activity has been initiated.

No.	Task to be developed	Specific tasks	Deliverables	Finalization date	Responsible	Supporting members to the task	Status of implementation
	3.1 Determine which methodology will be used in airspace safety and routes spacing, depending on navigation specifications, taking into consideration "airspace modelling", ATC simulations (accelerated and/or real time), live trials, etc	Analyse methodologies to enable safety priority to PBN implementation Determine methodology and adapt it.	Before PBN implementation it will be demonstrated that safety levels will be maintained or improved	SAM/IG/5	CARSAMMA	Jorge Fernández	Completed Include comments of report.
	3.3 Prepare preliminary airspace safety assessment	Collect necessary data Carry out a safety assessment applying methodology adopted	PBN will be implemented demonstrating that safety levels agreed will be maintained or improved	SAM/IG/5	CARSAMMA	Jorge Fernández	Valid
	5.1 Evaluate PBN implementation in ATC automated Systems, taking into consideration amendment 1 to PANS/ATM (FPLSG).			SAM/IG/4			Completed See Task N° 2-5 Not required for RNAV 5 implementation.
2-14	**Conclusion SAM/IG/2-4** **PBN Implementation Model for TMA and Approach** That States/Territories and International Organizations use the PBN Implementation Model for TMA and Approach in the preparation of their PBN implementation programmes for TMA and Approach, shown in **Appendix E** to this part of the Report.	Prepare action plans for PBN implementation in TMA and APP	Action plans accompanying regional implementation	SAM/IG/4	States PBN Focal Points	Jorge Fernández	Valid 11/2/09 Message was sent to States reminding them this Conclusion

No.	Task to be developed	Specific tasks	Deliverables	Finalization date	Responsible	Supporting members to the task	Status of implementation
2-15	Flexibility in special use airspace.	ANSPs will Establish coordination mechanism with military authorities Discuss matters such as location, altitudes, and validity periods of special use airspaces.	Obtain the efficient use of the airspace in terms coordinated and agreed between civil and military authorities, contemplating the benefit of all users	SAM/IG/4	States	N/A	Valid Information will be required at the SAM/IG/3 Civil/Military Coordination Forum. A Civil/Military coordination seminar/workshop shall be required for 2011.
2-16	Handling of air transport environmental problems	Obtaining of objective data over benefits that will be reached in terms of reduction of harmful gas emissions into the atmosphere.	Known data Availability of information required for monitoring of environmental protection.	SAM/IG/5	States	N/A	Valid Check fuel savings estimate chart.
2-17	Training in RNP approach procedures with required authorization**.**	Prepare SIP to have FAA instructors available	States Experts duly qualified in RNP APCH AR matters	SAM/IG/4	Regional Office	Brazil/Chile	Valid

No.	Task to be developed	Specific tasks	Deliverables	Finalization date	Responsible	Supporting members to the task	Status of implementation
Agenda Item 3: Standards and procedures for performance-based navigation operations approval							
3-1	**Conclusion SAM/IG/2-5** **Advisory Circular CA 91-002 and Job Aid for Aircraft and operators RNAV 5 operational approval** That States of ICAO South American Region: a) Use as an acceptable compliance source in aircraft and operators RNAV 5 operational approval Advisory Circular CA 91-002 and Job Aid for Aircraft and operators RNAV 5 operational approval, presented in **Appendices A** and **B**, respectively, to this part of the Report. b) Publish respective national regulations up to April 2009.	Publish national regulations on RNAV 5 Aircraft and users approval	Aircraft and users RNAV 5 duly approved and on time before initial date of implementation	In view that most States have not published in their national regulations the requirements corresponding to RNAV5 operations, the date of compliance was re-scheduled for 5 October 2009, date in which the corresponding RNP, APCH, RNP AR APCH and APV/baro-NAV operations requirements should also be published	States PBN Focal Points	Secretariat	Valid CA on RNAV/5 approved during SAM/IG/2. CAs on RNP, AR, RNP AR, APCH and APV/baro-NAV approved during SAM/IG/3 Meeting

No.	Task to be developed	Specific tasks	Deliverables	Finalization date	Responsible	Supporting members to the task	Status of implementation
3-2	Work Programme for the development of Advisory Circulars (CA)	Implement work programme approved in the meeting (See Appendix C SAM/IG/2) Agenda Item 3 During the SAM/IG/3 the work for CA development was re-scheduled (See Appendix A to Agenda Item 4 of the SAM/IG/3 Report)	LAR available for States of the Region	SAM/IG/3 SAM/IG/4 SAM/IG/5	RLA/99/901	Jorge Fernández/ Oscar Quesada/ Marcelo Ureña/ Verónica Chávez	Under development
Agenda Item 4: Implementation of air traffic flow management (ATFM) in the SAM Region							
4-1	Send ATFM survey to SAM ATFM Implementation Group Rapporteur	Complete information and send result	Evaluation of status of implementation of ATFM in SAM Region	December 2008	Secretariat	Jorge Fernández	Completed

No.	Task to be developed	Specific tasks	Deliverables	Finalization date	Responsible	Supporting members to the task	Status of implementation
4.2	**Conclusion SAM/IG/2-6** **ATFM Roadmap** That, a) the ATFM Roadmap in **Appendix B** to this part of the Report be adopted, with the aim of providing orientation to the ATFM community with regard to ATFM applications to be implemented in the short and medium term in the SAM Region; and b) the ICAO Secretariat send the ATFM Roadmap to the GREPECAS ATFM Task Force for the analysis and actions deemed pertinent.	States must adopt ATFM Roadmap sheet and inform on the intentions to national aeronautical community	Aeronautical Community in knowledge of regional and national activities related to ATFM ATFM roadmap shall be presented to the ATFM/4 Meeting	SAM/IG/3	States ATFM Focal points ATFM Rapporteur	ATFM Rapporteur/ Jorge Fernández/ Alberto Orero	Valid See Task 4-5 ATFM/5 will be held in Bogotá, Colombia, from 8 to 12 June 2009 The ATFM Roadmap will be presented at this meeting
4-3	Manual ATFM	Continue development of l ATFM Manual	States will have a Manual for harmonised application in the SAM Region	SAM/IG/4	Expert RLA/06/90	Jorge Fernández/ Alberto Orero	Valid Hiring of expert in process
4-4	Course for runway capacity ATC sectors estimate methodology	Dictate course	States will have available suitable personnel in order to define ATC sectors and airports capacity	SAM/IG/3	Brazil Secretariat	Jorge Fernández	Completed
4-5	ATFM AIC initial Model	Publish initial AIC	Aeronautical Community in knowledge of regional and national activities related to ATFM	7 May 2009	ATFM States Focal Points	Jorge Fernández	Completed

APPENDIX B

FOLLOW-UP OF CONCLUYESONS AND PENDING TASKS OF THE SAM/IG MEETING

Conclusión/Tarea Conclusion/Task	ARG	BOL	BRA	CHI	COL	ECU	FGY	GUY	PAN	PAR	PER	SUR	URU	VEN	OBSERVACIONES REMARKS
1-1 **SAM/IG/1-1** **CAR/SAM PBN Roadmap** That ICAO SAM States, in implementing RNAV/RNP, take the pertinent actions to follow guidelines contained in the CAR/SAM PBN Roadmap as shown in Appendix C to this part of the report..	**O/G**	**O/G**	**O/G**	**O/G**	**O/G**	**O/G**	--	--	**O/G**	**YES**		--	**O/G**	**O/G**	**COL:** May.2009 **VEN:** Oct.2009
1-4 That States examine: a) Impact of RNAV routes implementation in t he airspace b) Aircraft fleet c) Air traffic services, and Establish pertinent coordination so as to enable integrated, harmonious and timely implementation of more direct RNAV routes.	**O/G**	**O/G**	**O/G**	**O/G**	**O/G**	**O/G**	--	--	**O/G**	**O/G**		--	**O/G**	**O/G**	**PAR:** SAMIG 4 y 5 **COL:** June **VEN:** Oct.2009 **ECU:** Local coordination with corresponding area.
2-1 Implementation of RNAV routes	**YES**	**YES**	**YES**	**O/G**	**NO**	**YES**	--	--	**YES**	**O/G**		--	**YES**	**NO**	**VEN:** Missing to know PBN capacities of ACFT for domestic flights in order to define the need for implementation. **ECU:** Missing pronouncement of VEN for updating Guayaquil/Madrid implementation route.
2-3 **Conclusion SAM/IG/2-1** **PBN implementation Programme for en-route operations** That the ICAO SAM States take appropriate actions to follow the guidelines and comply with the targets established in the PBN implementation for en-route operations, which is shown in **Appendix B** to this part of the Report.	**YES**	**O/G**		**O/G**			--	--	**YES**	**O/G**		--	**YES**	**O/G**	**VEN:** Jul.2009 - Oct.2009

Conclusión/Tarea Conclusion/Task	ARG	BOL	BRA	CHI	COL	ECU	FGY	GUY	PAN	PAR	PER	SUR	URU	VEN	OBSERVACIONES REMARKS
2-10 **Conclusion SAM/IG/2-2 Initial AIC** That States of ICAO SAM Region uYESng as model the AIC presented in Appendix C to this part of the Report: a) publish in the AIRAC date of 9 April 2009 an Aeronautical Information Circular (AIC) informing the aeronautical community on their intention to implement RNAV 5 on 18 November 2010; b) reflect in this AIC the specific YEStuations within the airspace under their jurisdiction.	**YES**	**YES**	**YES**	**YES**	**O/G**	**YES**	**--**	**--**	**O/G**	**NO**		**--**	**YES**	**YES**	**COL:** June **ECU:** AIC published
2-12 **Conclusion SAM/IG/2-3** **Survey on the Fleet Navigation Capacity** That States conduct a survey on the fleet navigation capacity, uYESng, to that end, the form contained in **Appendix D** to this part of the Report, and send the information collected to the ICAO South American Regional Office, on the following dates: a) Aircraft operating commercial flights, which have more than 5 700 kg. of MTOW – 15 February 2009; b) Aircraft operating commercial flights, which have less than 5 700 kg. of MTOW – 15 May 2009; c) Other aircraft registered in the Region – 15 August 2009.	**YES**	**NO**	**O/G**	**OG**	**O/G**	**O/G**	**--**	**YES**	**O/G**	**NO**	**YES**	**--**	**O/G**	**O/G**	**COL:** June **ECU:** Developing **BRA:** Survey on comercial aircrafts with MTOW, has been delivered.
2-13 1.2 Collect air traffic data to understand air traffic flows in a specific airspace	**YES**	**O/G**	**YES**	**O/G**	**O/G**	**O/G**	**--**	**--**	**O/G**	**O/G**		**--**	**YES**	**YES**	**COL:** July **ECU:** Developing
2-14 **Conclusion SAM/IG/2-4** **PBN Implementation Model for TMA and Approach** That States/Territories and International Organizations use the PBN Implementation Model for TMA and Approach in the preparation of their PBN implementation programmes for TMA and Approach, shown in **Appendix E** to this part of the Report	**O/G**	**O/G**	**O/G**	**OG**	**O/G**	**O/G**	**--**	**--**	**O/G**	**O/G**		**--**	**O/G**	**O/G**	**PAR:** Foreseen/to be verified. **COL:** July **VEN:** Jul.2009 – Oct.2009 **ECU:** Developing

Conclusión/Tarea Conclusion/Task	ARG	BOL	BRA	CHI	COL	ECU	FGY	GUY	PAN	PAR	PER	SUR	URU	VEN	OBSERVACIONES REMARKS
2-15 Flexibility in special use airspace.	**O/G**	**O/G**	**O/G**	**OG**	**O/G**	**O/G**	**--**	**--**	**--**	**O/G**		**--**	**O/G**	**O/G**	**PAN:** Panama does not have army nor air force. **VEN:** Undetermined **ECU:** Will require information in SAM/IG/3 **CHI:** They have a committee responosible for these subjects.
2-16 Handling of air transport environmental problems	**O/G**	**NO**	**O/G**	**YES**	**NO**	**NO**	**--**	**--**	**O/G**	**O/G**		**--**	**O/G**	**NO**	**ECU:** Example: Chile SAM/IG/5
3-1 **Conclusion SAM/IG/2-5** **Advisory Circular CA 91-002 and Job Aid for Aircraft and operators RNAV 5 operational approval** That States of ICAO South American Region: a) Use as an acceptable compliance source in aircraft and operators RNAV 5 operational approval Advisory Circular CA 91-002 and Job Aid for Aircraft and operators RNAV 5 operational approval, presented in **Appendices A** and **B**, respectively, to this part of the Report. b) Publish respective national regulations up to April 2009.	**O/G**	**NO**	**O/G**	**O/G**	**NO**	**O/G**	**--**	**--**	**O/G**	**NO**		**--**	**O/G**	**O/G**	**PAR:** Developing **VEN:** Jul.2009 – Oct.2009 **ECU:** Coord. with OPS
4-2 **Conclusion SAM/IG/2-6** **ATFM Roadmap** That, a) the ATFM Roadmap in **Appendix B** to this part of the Report be adopted, with the aim of providing orientation to the ATFM community with regard to ATFM applications to be implemented in the short and medium term in the SAM Region; and b) the ICAO Secretariat send the ATFM Roadmap to the GREPECAS ATFM Task Force for the analyYESs and actions deemed pertinent .	**O/G**	**O/G**	**O/G**	**O/G**	**O/G**	**O/G**	**--**	**--**	**O/G**	**O/G**		**--**	**O/G**	**O/G**	**PAR:** Final verification **COL:** ATFM/4 **VEN:** Oct.2009 **ECU:** ATFM

Conclusión/Tarea Conclusion/Task	ARG	BOL	BRA	CHI	COL	ECU	FGY	GUY	PAN	PAR	PER	SUR	URU	VEN	OBSERVACIONES REMARKS
4-5 Manual ATFM	**YES**	**YES**	**N/A**	**O/G**	**O/G**	**YES**	**--**	**--**	**O/G**	**O/G**		**--**	**YES**	**O/G**	**ECU:** AIC published **COL:** June **PAR:** In Publishing process **URU**: AIC published 07 May 2009 **VEN:** Mar.2010

Instrucciones para el llenado del formulario - Instructions to fill in the form

- Cumplida: colocar **Sí** en el caYESllero correspondiente. / Accomplished: place **YES** in the corresponding box
- En ejecución: colocar **O/G** (on going) e indicar en "observaciones" la fecha prevista de término./ In execution: place **O/G** (on going) and indicate under "remarks" the estimated deadline
- No cumplida: colocar **NO** en el caYESllero correspondiente y, de ser el caso, hacer comentarios en columna de observaciones/ Not complied: place **NO** in the corresponding box and if such were the case, make comments in the remarks column

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Agenda Item 2: Optimization of the ATS routes structure

RNAV Routes Implementation

2.1 The Meeting kept in mind that the optimisation of the ATS routes structure in the terminal airspace (SID/STAR and RNAV) and en-route (RNAV), as well as the implementation of RNP approaches are associated to **Result 1.1 of Immediate Objective N° 1 of Project RLA/06/901**, Implementation of performance based navigation (PBN). Within this optimisation, the ATS routes network will continue to be improved, and if such were the case, and in consultation with users and IATA those conventional routes that are not used by airspace users will be eliminated and will be replaced by RNAV routes.

2.2 During SAM/IG/01 Meeting, the need was recognized States review their respective national RNAV implementation programmes to be compatible with the SAM Region RNAV implementation programme. It was also agreed to continue with the revision, implementation, modification or elimination of routes in the SAM Region, to continue with the ATS routes structure optimization.

2.3 During the meeting, a series or RNAV routes were evaluated for their implementation. Therefore, several ad-hoc groups were created, and composed by delegations of IATA and the States involved, to analyse the feasibility of its implementation, agreeing that ad-hoc groups created to carry out such works, would have a 30 days deadline upon the finalisation of such meeting, in order to review within the environment of their respective administrations, and propose the changes deemed pertinent. The result of this revision is shown in **Appendix A** to this part of the report.

2.4 It was also agreed that the communications channels to be used for this coordination would be the use of tele-conferences previously agreed by e-mail. The results of such coordination should be informed to the Secretariat, in order to enable the preparation of the corresponding proposal for amendment to CAR/SAM ANP Table ATS.

Feasibility study for optimising the ATS route network in the South American Region

Background

2.5 The Meeting recalled that the 36th ICAO General Assembly requested the Council to encourage Contracting States to improve air traffic efficiency--that resulted in less emissions--, report on the progress in this area, and expedite the development and implementation of routings and procedures allowing for efficient fuel consumption to reduce aircraft emissions.

2.6 It also recalled that the ALLPIRG/5 meeting, held in March 2006, concluded to establish a global, consolidated, and prioritised list of route and terminal area (TMA) improvements, in close coordination with airspace users; and also that neighbouring PIRGs/States/air navigation service providers (ANSP) work to expedite improvements on international routes.

2.7 In this sense, the ICAO regular programme, among other implementation projects, has focused on the optimisation of the ATS route network. In this respect, the meetings of the SAM Implementation Group (SAM/IG) are being held under the auspices of the new Regional Project RLA/06/901. One of the objectives of these meetings/workshops is to organise the ATS route network of the South American Region. The first two meetings/workshops of the SAM Implementation Group (SAM/IG/1 and SAM/IG/2) reviewed the status of the route network, and noted that there are still some matters identified in these meetings, which make it difficult to reach the effectiveness goal, required in the optimization, but that with the actions being carried out between States and IATA, these are being diminished or eliminating, if such were the case.

2.8 The SAM Region has focused its attention on further improving airspace structure in order to achieve an inter-functional air traffic management system available to all users during all flight phases, that meets the agreed safety levels, provides cost-effective operations, is environmentally sustainable, and meets national security requirements.

2.9 In order to achieve the above, the SAM/IG/2 meeting deemed it appropriate to conduct a feasibility study to develop an ATS route network that responds to the new aviation requirements and takes into account the new performance-based navigation operational concept.

2.10 Taking into account the diversity of scenarios in the Region, the meeting felt that this would be a very complicated task and should be supported by Regional Project RLA/06/901, in order to first make a diagnosis of the existing ATS route network, develop a strategy for carrying out the task in phases, if applicable, prepare a list of deliverables, propose a work programme, identify the data needed and the method for their collection, define the necessary support tools to perform the task, specify the reference documentation required, and other aspects deemed relevant for the task, such as the interests of the States, geographical characteristics, etc. In addition to the aforementioned aspects, safety issues and other expectations described in the global ATM operational concept should be taken into account.

Feasibility Study for Optimising the ATS Route Network in the South American Region

2.11 The meeting noted the Feasibility Study for Optimising the ATS Route Network in the South American Region, attached as **Appendix B** to this part of the report, and, was conducted with a view to:

a) establishing the planning criteria that were used for assessing the SAM ATS route network;

b) presenting a general diagnosis of the SAM ATS route network; and

c) proposing a Programme for Optimising the SAM ATS Route Network, by phases, involving the establishment of a methodology for modifying the route network and leading to gradual improvements in the regional airspace structure.

Planning Criteria

2.12 The planning criteria established in the Feasibility Study for Optimising the ATS Route Network in the South American Region were based on the EUROCONTROL Manual for Airspace Planning (ASM.ET1.ST03.4000.EAPM.02.02), which can be obtained from the following web page: **http://www.eurocontrol.int/airspace/gallery/content/public/EUROCONTROL%20APM%20V2_Ed_Released%20Issue_Amendment%202_010606.pdf**. Those interested in deepening the analysis contained in Chapter 2 of the feasibility study should refer to the aforementioned document. This document, as well as other reference materials may also be found at the ICAO PBN website, selecting: documentation: **http://www2.icao.int/en/pbn/Pages/Documentation.aspx** .

2.13 It is important to note that the general diagnosis of the SAM ATS route network was done based on the aforementioned planning criteria. These criteria should be used to develop the new route network versions, as envisaged in the programme for optimising the SAM ATS route network.

Analysis and Diagnosis of the SAM ATS Route Network

2.14 In general, the analysis and diagnosis of the SAM ATS route network established that the main problem was that its development had always been based on the specific requirements of isolated routes, without a global analysis encompassing broader operational requirements aiming at a functional inter-relationship among the various elements of the airspace structure, such as: ATS routes, control sectors, control areas, TMAs, etc.

2.15 Another important issue is that, as already mentioned, the result of the work done by the States with the support of project RLA/98/003 resulted in the implementation of 77 RNAV routes, the modification of 58 route paths, and the elimination of only 7 routes. Although the work done addressed the operational requirements of airspace users, the addition of RNAV routes to the existing airspace structure in some cases resulted in increased airspace complexity.

2.16 The complete analysis of the SAM ATS route network is shown in Chapter 3 of the Programme for Optimising the ATS Route Network in the South American Region.

Programme for Optimising the SAM ATS Route Network

2.17 Based on the SAM ATS Route Network Planning and analysis/diagnosis Criteria, the Feasibility Programme for Optimising the ATS Route Network in the South American Region has concluded that the optimisation of the SAM route network should be done in phases, in order to derive the corresponding operational benefits as soon as possible. Starting on phase 2, the concept of route network versions would be incorporated, taking into account that the airspace structure changes as a function of air traffic growth, the shifting of air traffic demand from one region or airport to another, and available technology, among other factors. The use of route network versions reflects the need for an integrated periodic review to ensure the best possible airspace structure.

2.18 In view of the above, the meeting adopted the following conclusion:

Conclusion SAM/IG/3-1 ATS Route Network Optimising in the South American Region

That the ICAO SAM States take relevant action to follow the guidelines and meet the target dates established in the ATS Route Network Optimising Programme in the South American Region that appears in **Appendix B** to this part of the report.

Tasks of the Programme for Optimising the SAM ATS Route Network that must be completed by the SAM/IG/4 meeting

Collect traffic data to understand airspace traffic flows

2.19 The meeting was of the opinion that statistical data are essential to create an airspace structure that conforms to airspace planning principles and techniques. Traffic data must be periodically collected in order to analyse the evolution of air traffic demand in the Region. Consequently, SAM States must use the form contained in **Attachment to to Appendix B** to this part of the report, to collect the necessary data for the development of version 1 of the SAM route network. It is critical for the States to complete the form according to the instructions in order to ensure that the data can be effectively used for the analysis and to facilitate processing. Accordingly, the meeting adopted the following conclusion:

Conclusion SAM/IG/3-2 Data Collection

That SAM States:

a) collect data on all flights carried out in the SAM Region upper airspace (FL 245 or above) in national and international routes in the period **1-31 July 2009** and send them to the SAM Regional Office before **30 September 2009.**

b) use a sample consistent with the **form and the instructions for completing the form**, contained in **Attachment 2 to Appendix B** to this part of the report, using the EXCEL format.

Analyse the Fleet Navigation Capacity

2.20 The fleet navigation capacity must be known in order to determine the airspace volume in which RNAV can be applied on an exclusionary basis in order to optimise aircraft flow while reducing airspace complexity and pilot and air traffic controller workload. This task corresponds to task 1.3 of the RNAV-5 Implementation Programme and is being fulfilled under project RLA/99/901.

Define the Gateways for the Main TMAs in the SAM Region

2.21 As foreseen in Resolution 36/23 of the 36th ICAO Assembly and Conclusion 15/38 of GREPECAS/15, the States must submit their National PBN Implementation Plans by December 2009. For purposes of planning and implementing the PBN in the TMAs, the States shall develop their own airspace concept, which will help them define the gateways for the main TMAs in the SAM Region. version 1 of the route network will only include TMA gateways for those States that have already started their PBN implementation process or some other form of TMA airspace restructuring. This phase should also take into account State information available for the development of version 1.

Identify and Obtain the Necessary Tools for the Development of version 1 of the Route Network (aeronautical charts, specific software)

2.22 The detailed study envisaged under item 2.2.5 of the Action Plan for Phase 2 will require specific tools, such as aeronautical charts and specific software, for properly analysing the SAM route network. Such tools will also be necessary for the workshop foreseen in 2.2.6 of that same action plan. Consequently, Regional Project RLA/06/901 shall identify these tools and find a way to obtain them. In general terms, there will be a need for aeronautical charts containing the route network, the main TMAs, the SIDs and STARs, and the approach procedures for the major airports in the SAM Region. Likewise, it is advisable to use flight-planning software (*e.g.,* FliteStar of Jeppesen) containing the information mentioned in the aeronautical charts in order to facilitate data management. It would also be advisable to use software to design new routes, with automatic determination of approximate geographical coordinates of significant points.

Interface between the CAR and SAM ATS Route Networks

2.23 One of the most complicated aspects of the detailed study of the SAM ATS route network for drafting version 1 of the route network is the interface between the CAR and SAM Regions. The best option to perform this task would be a joint effort by the two Regions, following the model of the AP/ATM meetings. However, if this joint effort is not possible, experts should work on one of the two following options:

a) Propose a link between version 1 of the SAM route network and the items that might be considered to be the most appropriate, such as the WATRS airspace, and request the CAR Region to assess the proposal according to the mechanisms established by the NACC Office.

b) Use the existing boundaries between the adjacent FIRs of the two Regions as a basis for the development of version 1 of the SAM route network.

2.24 Considering that the interface between the two route networks is an issue that will require extended coordination between the NACC and SAM Offices, it would be advisable for the Meeting to start discussing the proposed strategies in order to begin the cited coordination.

Tasks to be developed in 2010

2.25 The meeting agreed that the following tasks must be developed by Project RLA/06/901 during 2010:

a) Carry out a detailed study of the ATS SAM routes network, with a view to preparing version 1 of the routes network (Ref 2.2.2 of the Action Plan of the SAM Region ATS routes network optimising Programme.

b) Prepare safety assessment required applying a qualitative methodology through the use of SMS (Ref. 2.2.3).

c) Carry out a Workshop of SAM States experts, in order to review and validate the study of item 2.2.5 (Ref 2.2.4).

Reduction in CO^2 emissions of route UL 797

2.26 The meeting noted the results presented by Chile, in terms of CO^2 emissions, derived from the implementation of route UL 797, which joins Diego Aracena Airport in Iquique City (Chile) and Viru Viru Airport in Santa Cruz de la Sierra (Bolivia).

2.27 In order to reach to accurate figures, this analysis proposes that, each kilogram of fuel saved, results in the non emission of:

- 3,187 Kg of CO^2
- 1,239 Kg of H_20
- 0,02112 Kg of NO^3
- 0,00098 Kg of SO^2
- 0,00056 Kg of CO

2.28 Air route UL797 started to be used in July 2008 by LAN airline, with a three-weekly flights, its trajectory has 89 NM less than the conventional air route previously used.

2.29 In accordance to the figures delivered by the airline, since July 2008 to February 2009, a total of 213 were carried out in A319/320, which resulted in a reduction of 89 NM of the RNAV route to 11 minutes less of the flight.

2.30 An A320 in average consumes 43 Kg of fuel per minute of flight (more information of fuel consumption in the table below) for each flight, a saving of 473 Kg of fuel, which means that 1.507 Kg of CO^2 are saved every time this route is used by an A320. During the period analysed (213 flights), 321 tons of CO^2 are saved to the atmosphere.

2.31 This simple analysis turns complex when the fleet using the route is mixed, or when it is not possible to access the data of the new air route in a clear manner, especially if it crosses more than two States.

2.32 The meeting also noted that there are some estimation tools for CO^2 emissions available, such as the one delivered by IATA during the SAM/IG/2 Meeting, which would help to obtain approximate figures, once it is established what, how and when shall we collect the necessary information to initiate this task.

Referential table of fuel consumption per Aircraft type. *

AIRCRAFT	**TAXI** typical average fuel burn: KG per HOUR	**TAKE-OFF** typical average fuel burn : KG per HOUR	**CLIMB** typical average fuel burn: KG per Hour	**APPROACH** typical average fuel burn: KG per HOUR	**CRUISE** typical average fuel burn: KG per HOUR	**CRUISE** typical average fuel burn: US Gallons per HOUR
A310	1382	15494	12751	4248	**4997**	1611,94
A319	728	7567	5949	2095	**2398**	773,55
A320	749	8143	6660	2210	**2556**	824,52
A321	770	8395	6919	2347	**2794**	901,29
A330-300	1954	23040	18576	6048	**6499**	2096,45
A340-300	1692	18835	15494	5126	**7500**	2419,35
B717-200	756	7084	5796	1956	**2200**	709,68
B727-200	1595	12042	10206	3675	**4432**	1429,68
B737-200	1063	8028	7178	2450	**2950**	951,61
B737	835	9245	7510	2513	**2900**	935,48
B747-400	2958	29592	24163	10930	**11200**	3612,90
B757-200	1440	12614	10404	3571	**4000**	1290,32
B767-200	1479	14796	12082	4200	**5000**	1612,90
B767-300	1433	17280	13730	4579	**5400**	1741,94
B777-200	1858	25279	19951	6530	**7697**	2482,90
CL60	311	2503	2074	744	**1050**	338,71
CRJ-200	352	2874	2367	835	**1200**	387,10
DC10	2650	26352	21596	7348	**9000**	2903,23
DC9	921	8928	7178	2549	**2866**	924,52
E135	323	2584	2159	775	**1000**	322,58
F100	792	5472	4536	1656	**2398**	773,55
L1011	1872	27108	20941	7992	**8500**	2741,94
MD11	2300	28836	22518	7592	**9180**	2961,29
MD82	986	9230	7524	2613	**3180**	1025,81

*Average Consumption Data Source: Transport Canada 2005

APPENDIX A

Montevideo - Buenos Aires Air lift

Uruguay has not yet arranged these airspace sectors nor implemented CNS improvements already planned for this route. In view of the above, the proposed implementation of this route is pending.

RNAV VOR CRR/VOR FNO Route

No information of the trajectory and geographical coordinates of significant points by Brazil has been received yet on this respect.

UM 662 Guayaquil – Madrid

Within the Civil/Military coordination, Venezuela continues coordination with the Venezuelan Air Force a trajectory within the Venezuelan airspace. Once such trajectory is obtained, it shall be informed to the ICAO SAM Regional Office to continue with the coordination.

UM 527 Lima – Madrid

States involved have agreed that the date for implementation of this route shall be 27 August 2009.

Santiago – Sao Paulo

States involved, Argentina, Brazil and Chile, agreed to incorporate this item in the Feasibility Study for ATS routes network optimisation in the South American Region.

Santiago – Miami

From coordination carried out by Chile, Peru and IATA it was agreed to evaluate the following trajectory:

Santiago – UL 302 up to VOR LIMA – VOR CHACHAPOYA – KORBO – BOKAN - VOR LA PALMA – CIEGO DE AVILA – URSUS-

Comparison of distances:

UL 780: (Santiago – URSUS) 3.521 NM

Trajectory proposed: 3. 504 NM

According to the trajectory under study, coordination shall continue with States involved and IATA, in order to agree the definitive route and proceed to its implementation in the pertinent time and manner.

APPENDIX B

Programme for Optimising the ATS Route Network in the South American Region

1. Introduction

The main objective of the Airspace Organisation and Management (AOM) component of the Global ATM Operational Concept is to maximise efficient airspace use, while maintaining the required level of safety.

Incorporation of the Global ATM Operational Concept into the Global Air Navigation Plan facilitated the planning and implementation of new and innovative methods that make significant improvements in airspace organisation and management possible. The set of Global Planning Initiatives (GPI) directly involved in AOM offer the necessary guidelines for planning and implementing an optimum airspace structure, among the most important of which are:

a) GPI 1 –Flexible Use of Airspace

b) GPI 5 – RNAV and RNP

c) GPI 7 – Dynamic and Flexible ATS Route Management

d) GPI 8 – Collaborative Airspace Design and Management

e) GPI 10 – Terminal Area Design and Management

f) GPI 11 – RNAV and RNP SIDs and STARs

PBN implementation (GPI 5) will facilitate the use of advanced aircraft navigation capabilities, which, combined with the air navigation system infrastructure, will make it possible to optimise the airspace, including the route network. This will favour ATS routing that will meet the needs of airspace users, thereby reducing controller and pilot workloads and the concentration of aircraft in specific portions of the airspace.

Recognising the importance of PBN for AOM, the 36th ICAO Assembly established Resolution 36/23 urging States to implement ATS routes and RNAV and RNP approach procedures, based on the PBN Manual (Doc. 9613). The 36th Assembly also resolved that States and Regional Planning and Implementation Groups (PIRGs) should prepare a PBN implementation plan by 2009.

Before approving the Global ATM Operational Concept and the new Global Air Navigation Plan, CAR/SAM States, Territories, and International Organisations reviewed the ATS route network and implemented new RNAV routes, with the assistance of Project RLA/98/003 through its support for meetings of ATM authorities and planners --ATM (AP/ATM)-- , thereby helping to reduce some paths, leading to a compatible transition between the en-route flight phase and terminal control areas. It also made it possible to develop the CAR/SAM PBN Route Map, approved through GREPECAS/14 Conclusion 14/46.

As a result of the efforts of States with the support of project RLA 98/003, 77 RNAV routes have been implemented, the flight paths of 58 routes have been modified, and 7 routes have been eliminated. The ICAO Council has approved the respective amendments to the CAR/SAM ANP Route Network.

At the request of States and International Organisations, the ICAO regular programme has, among other implementation projects, focused its attention on optimising the ATS route network. In this respect, the meetings of the SAM Implementation Group (SAM/IG) are being held under the auspices of the new RLA 06/901 project. One of the aims of these meetings is to optimise the ATS route network in the South American Region. During its first two meetings, the SAM Implementation Group (SAM/IG/1 and SAM/IG/2) analysed the current state of the route network and confirmed the following:

a) Some routes have not met expectations as to their use by operators, despite the insistence of the latter on their implementation;

b) It was noted that some routes, although duly implemented, are in little use because the operators prefer less direct ATS routes, which result in higher operating costs and, in some cases, less airspace capacity and flexibility;

c) A large number of RNAV routes have not yet been linked through the SID and STAR procedures established in the TMAs, making flight and ATC operation difficult;

d) Airspace complexity is more related to air traffic movement than to airspace design *per se*. As a result, in some cases, routes with low traffic could be maintained so long as the corresponding operational benefits are obtained.

The SAM Region has seen the need to further improve the airspace structure, in order to achieve an inter-functional air traffic management system available to all users during all flight phases, that meets the agreed safety levels, provides cost-effective operations, is environmentally sustainable, and comply with national security requirements.

In order to achieve the above, the SAM/IG/2 meeting deemed it appropriate to conduct a feasibility study to develop an ATS route network that would meet the new aviation requirements and provide for the new performance-based navigation concept.

Considering the diversity of scenarios in the Region, the Meeting felt that this task would be very complicated and should be supported by the Regional Project RLA/06/901, in order to first make a diagnosis of the existing ATS Route Network, develop a strategy for carrying out the task in phases, if appropriate, prepare a list of deliverables, propose a work programme, identify the data needed and the means for their collection, define the necessary support tools to perform the task, specify the reference documentation required, and other aspects deemed relevant for the task, such as the interests of each State, geographic characteristics, etc. In addition to the aforementioned aspects, safety issues and other expectations described in the Global ATM Operational Concept should be taken into account.

Optimising the ATS route network in the South American Region is expected to contribute to the accomplishment of the following Strategic Objectives of ICAO:

A: Safety — *Enhance global civil aviation safety*

C: Environmental protection — *Minimise the adverse effect of global civil aviation on the environment*

D: Efficiency — *Enhance the efficiency of aviation operations*

2. Planning criteria

2.1. General Considerations

This chapter of the programme was based on the EUROCONTROL Manual for Airspace Planning (ASM.ET1.ST03.4000.EAPM.02.02), which can be obtained at the following website address:http://www.eurocontrol.int/airspace/gallery/content/public/EUROCONTROL%20APM%20V2_Ed-2_Released%20Issue_Amendment%202_010606.pdf. Those interested in deepening the analysis contained in this chapter are recommended to refer to that document.

The ATS route network should serve as a basis for airspace organisation and air traffic service requirements. It should be established in such a way as to permit most flights to operate on direct routes, or as close to such routes as possible, in order to unite flight origin/destination areas. This structure must be operationally viable. In order to achieve optimum ATC capacity, it may be necessary to establish non-optimum flight levels and/or paths, but this could reduce the complexity of the airspace structure.

There is a very close relationship between the route network structure and airspace sectorisation. Therefore, that relationship should be considered as of the planning phase, in order to ensure the viability of sectorisation that would make optimum ATC capacity possible, including the possibility of ATS delegation. Definition of the route type (one-way/two-way) and the direction of one-way routes can take into consideration the need for more efficient sectorisation. In more complex airspace structures, validation through ATC simulations may be necessary before implementation.

Civil/military coordination is essential to ensure route network efficiency. The flexible use of airspace (FUA) concept is of key importance for guaranteeing that the requirements of all airspace users are met. FUA application permits the implementation of additional direct routes, as of the moment direct aircraft routing practices are adopted at the ATC tactical level, in cases where temporary special use airspaces (SUA)[1] are not activated. Automatic flight plan reprocessing may facilitate FUA application, permitting flight planning, if information about SUA availability for civil aviation is made viable sufficiently in advance.

Definition of the main traffic flows should include domestic air traffic routes and segments, in order to make the development of an integrated structure possible in the initial planning phase. Efforts should be made to eliminate points of congestion. In that case, special care should be taken to avoid worsening the situation of one area when attempting to resolve problems in another area.

The number of ATS routes should be kept to a minimum, always considering the traffic demand in relation to ATC capacity and the possibility of applying direct routes. Utilisation of a large number of ATS routes improves the possibility of using direct routes. Having a large number of crossing points, however, especially in areas that are already congested, normally reduces ATC capacity, in accordance with growing airspace complexity. Airspace planners should optimise ATC capacity by introducing new routes with the least number of crossing points possible and/or inserting the crossing points as far from the congested areas as possible. In that way, if the implementation of a new route is planned to accommodate a foreseen demand in air traffic that is not confirmed during the implementation phase, its implementation should be reconsidered. Furthermore, redundant ATS routes should be eliminated.

The use of one-way routes should be considered, particularly in areas where the interaction between ascending/descending traffic is a limiting factor, and represents an advantage in improving airspace structure that will lead to increased ATC capacity in ATC sectors. Likewise, in congested areas, aircraft overflights should not, insofar as possible, cross each other or interfere with the arrival and departure flow of the main TMAs, and the duration of possible crossings should be minimised and preferably carried out at 90º angles.

2.2. Use of Performance-Based Navigation

The use of Performance-Based Navigation creates the necessary conditions for optimising the ATS route network, inasmuch as it makes it possible to harmonise aircraft and operator approval criteria for en-route RNAV operations and permits the establishment of appropriate route spacing with the application of the Protected Airspace Concept. With PBN implementation, the airspace can be made less complex through the elimination of conventional routes, reduction of crossing points between flight paths, and orderly arrangement of the airspace as a whole.

[1] Special Use Airspaces are those provided for in Doc 8126 (AIS Manual), which should be inserted in the ENR part of the AIP of each State, as follows:
ENR 5.1 –Restricted / Prohibited / Dangerous Areas
ENR 5.2 – Areas for Training and Military Exercises / Air Defence Identification Zones (ADIZ)
ENR 5.3 – Other Dangerous Activities and Other Potential Risks

2.3. Regional Routes and Domestic Routes

In airspaces where international operations are responsible for most of the traffic, development of the route network requires coherent coordination among the States involved. In airspaces where most of the air traffic consists of domestic operations, the route network must be harmonised with the adjacent States, in order to optimise the airspace structure.

Isolated State development of domestic ATS routes should be limited to airspaces that serve national purposes only. In addition, such efforts normally have direct and perceptible effects on air traffic beyond the jurisdiction of the State involved.

Development of a harmonised and consistent route network requires active participation by States in the international working groups formed to establish or review the regional route network, considering a top down strategy, based on regional operational requirements for increasing ATC capacity, bearing in mind the following criteria:

a) First, identify the main regional air traffic flows, together with those that extend beyond the Region and have a direct impact on the regional route network, in order to seek out shortcomings in the route network and in ATC sector organisation.

b) Establish and review the ATS route network and support sectorisation in order to accommodate the main air traffic flows, thereby reducing airspace complexity and balancing ATC workload.

c) Integrate the required routes to provide access to the regional route network from/to airports not served by it. It is also necessary to integrate non-permanent routes that are needed to alleviate the air traffic load in the main ATS routes and to ensure flight at the most optimum profile possible.

d) Ensure connectivity between the ATS route network from/to TMA airspace.

e) Establish phased implementation to ensure consistency with State implementation.

2.4. Relationship between ATS Routes and Control Areas (CTA)

Use of Control Areas (CTA) in significant portions of the airspace beyond the ATS routes has the advantage of allowing the controller, when air traffic conditions permit, to authorise a specific flight under his/her control to deviate from an established ATS route without having the aircraft leave the controlled airspace and without losing the ATC benefits.

Within the CTA, however, the protected airspace of ATS Routes is not visible, because, by definition, all airspace around the routes is controlled airspace and this does not facilitate the demarcation of special use airspace (SUA) adjacent to ATS routes. On the other hand, establishing ATS routes in the form of corridors (airways) offers a clear description of the associated protected airspaces, within which controlled flights should remain.

To give flexibility to VFR flights outside airways and TMAs, the lower limits of controlled airspace must be established in order to avoid unnecessarily restricting flights that do not require air traffic control services, while keeping IFR traffic within the controlled airspace during the departure, en-route, arrival and approach phases.

2.5. Flexible Use of Airspace (FUA)

Most ATS routes must be established on a permanent basis. There are cases, however, in which the application of non-permanent routes, in keeping with the existence of temporary special use airspace (SUA), can make it possible to optimise the airspace structure, either reducing the traffic load on the main routes or permitting flights at more convenient profiles.

By way of example, EUROCONTROL has established Conditional Routes (CDRs), according to a specific classification for each operational situation:

a) CDR 1 – Routes that can only be used during specific periods, for example, during weekends or at night. These routes can be used permanently for flight planning purposes during the periods specified in the AIP. Changes in periods specified in the AIP should be published through standard AIS procedures.

b) CDR 2 – Routes that can be used through pre-tactical coordination procedures established by the Airspace Management Control (AMC) units. These routes can be used for flight planning, but not permanently, depending upon AMC coordination. They normally depend upon the capacity for reprocessing flight plans.

c) CDR 3 – Routes that can be used tactically by the ATC unit through direct coordination between the ATC and the user of the special use area. These routes are not used for flight planning purposes.

ATS routes used under the Flexible Use of Airspace concept should be included in the ATS route network, with a clear indication of the limitations imposed by their non-permanent nature. These routes should be reviewed at regular intervals in order to assess their type (1, 2 or 3), whenever fuller use of these routes is needed.

2.6. Protected Airspace – Route Spacing Concept

Item 2.11 of Annex 11 establishes the requirement to provide protected airspace and adequate spacing between adjacent ATS routes. This spacing between the centre lines of parallel runways where PBN is applied depends upon the type of RNAV or RNP specified by each State or on the basis of regional agreements.

In the case of RNAV-5 (B-RNAV) application in Europe, the minimum route spacing was established at between 10 and 15 NM, depending upon whether or not radar was used and ATC intervention capacity.

Route spacing should be assessed as provided for in Doc. 9689, bearing in mind, among other aspects, the available ATS surveillance capacity and air traffic controller workload.

2.7. Harmonisation in route network publication

Doc 8126 (AIS Manual) recommends that part ENR 3 of the AIP contain a list of all ATS routes established within the territory of a State, whether as part of the Regional or of the National Route Network.

As specified in Doc. 8126 (ENR 3 – ATS Routes), a description of the special procedures required in a route or part of a route must be included where applicable.

Under these circumstances, permanent or non-permanent routes should be listed together, inasmuch as a route can contain permanent and non-permanent segments. Special procedures for each route or segment, however, should be published in a specific part of the AIP.

2.8. Planning Principles

The planning principles for developing an ATS route network were established in the Guide for the Implementation of RNAV Routes in the CAR/SAM Regions, approved through Conclusion 12/7 of the GREPECAS/12 meeting. To facilitate reference to those principles, they will be included in this document.

2.8.1. Airspace planners should keep the following planning principles in mind:

a) Air traffic volume in existing and proposed routes;

b) Establishment of the shortest routes possible for most of the flights;

c) Prioritise the planning of areas of greater air traffic volume;

d) Meet the needs of civil and military users;

e) Integration of the route network and support sectorisation at the start of the planning process;

f) Integrate the route network and the TMA arrival and departure flight paths (SIDs and STARs).

2.8.2. **Air traffic volume in existing and proposed routes**

Considering the advantages of RNAV routes and the growing number of users trained in RNAV flight, implementation of an RNAV route normally absorbs most of the air traffic of one or more "conventional" routes. Therefore, the elimination of any of the existing "conventional" routes should be evaluated and accomplished, if necessary, through an analysis of the air traffic volume in each of the routes involved, whether they are RNAV routes or not. It is important to stress that maintaining "conventional" routes for a small number of users not equipped for RNAV flights does not necessarily mean increasing airspace complexity, for that complexity is due to the number of existing flights for each route and not to the additional crossings that would appear on the aeronautical charts.

2.8.3. **Establishment of the shortest routes possible for most of the flights**

Considering the need to serve most users at their optimum flight profiles, the establishment of direct routes as close as possible to the origin/destination paths should be prioritised. Inasmuch as the RNAV route normally absorbs most of the air traffic, implementation of the RNAV route will most likely take preference over the "conventional" route. It is important to emphasise that it may be necessary to maintain routes for users whose aircraft are not RNAV-equipped. Inasmuch as it is not always possible to establish a route between origin and destination, the need should be considered for implementing specific one-way routes for departure from and arrival at a TMA, using specific arrival and departure control sectors. Airspace planning should consider the requirement for establishing new airspace sectorisation when beginning the implementation of a new version of the route network.

2.8.4. **Prioritise the planning of areas of greater air traffic volume**

In order to accomplish the aim of giving most users the shortest routes possible, airspace planning should start in airspace regions with the greatest air traffic volume and proceed to those with the least volume, giving priority to flows with the highest air traffic volume.

2.8.5. **Integration of the RNAV route network and support sectorisation at the start of the planning process**

Adequate airspace sectorisation needs to be guaranteed from the very beginning of the planning process. Furthermore, the planning should not consider FIR boundaries, in order to create a seamless airspace, including, if necessary, the delegation of air traffic services.

2.8.6 **Integration of the route network and TMA arrival and departure paths**

Integration of the RNAV route network and TMA arrival and departure paths should be considered during the initial planning phase for implementation of a new route network, considering the need to reduce pilot and air traffic controller workloads, mainly through more effective use of flight management systems (FMS) and by reducing the ground/air/ground communications load.

2.9. Concepts facilitating route network implementation

Some concepts facilitate consistent and harmonised implementation of a route network.

These concepts are:

a) PBN – as already mentioned in item 2.2

b) FUA – as already mentioned in item 2.5

c) Seamless Airspace – Route network planning and implementation should be accomplished with the application of the seamless concept, without considering FIR boundaries. ATS delegation should be applied as needed to increase ATM capacity and efficiency. This delegation should normally occur:

- When the crossing points are located near the FIR or sector boundaries, to give the controller the necessary information sufficiently in advance to be able to manage the traffic entering the adjacent FIR.
- When the flying time in a given FIR is short, in order to reduce coordination among ATC units responsible for adjacent FIRS, thereby reducing the workload.
- In TMA sectors, to allow the controller to anticipate the regulation/radar vectors for the incoming flow.

d) RVSM – RVSM has permitted the application of additional flight levels that favour the conditions required for distributing aircraft into Flight Level Assignment Systems (FLAS), in order to improve flight safety, thereby minimising the effect on the efficiency of air operations.

2.10 Planning Techniques

2.10.1. Establishment of specialised routes

In high traffic density areas, additional ATC capacity may be obtained by segregating arrival and departure routes and separating them from overflight routes. This increase in capacity is due to the fact that this structure normally avoids conflicts among ascending and descending aircraft and between these and overflying aircraft. As a result, this structure should be applied for the arrival and departure phases. Application of Continuous Descent Approaches (CDAs) depends upon the establishment of specialised arrival paths, through either one-way routes or STARs, with the least possible number of crossings, to allow aircraft to descend without interruption.

2.10.2. Establishment of specialised sectors

Based upon the structure described in item 2.10.1, specialised sectors may be established by grouping routes of a similar nature, like arrival sectors, departure sectors or overflight sectors. These sectors are applied especially in ACC sectors responsible for "feeding" a highly complex TMA, as well as in TMAs themselves.

2.10.3. Crossings as close as possible to the origin of the flights

The route network must be developed in such a way that the essential route crossings used by the main traffic flows are as close as possible to their origin. Considering the complexity of the area of origin, however, it may be appropriate to transfer the crossings to areas with lower traffic/route densities. Crossings should also be executed preferably in areas with ATS surveillance.

3. Analysis and Diagnosis of the SAM ATS Route Network

3.1. General Considerations

The purpose of this chapter is to make a general analysis and diagnosis of the SAM ATS route network, in light of the planning criteria presented in chapter 2. The items in this chapter correspond to the items in chapter 2, in order to facilitate an understanding of the criteria applied in the analysis and diagnosis of the SAM ATS route network.

Based on material available at the ICAO South American Office, it can be noted that information was already available in 1957 about the development of a route network for the SAM Region and the South Atlantic. It can also be noted in reports of the First and Second CAR/SAM Air Navigation Meetings, held in 1976 and 1989, respectively, that the stability of the route network was always a matter of concern and that there were a prevalence of isolated State initiatives for the development of their own route networks. There were initiatives in the Region for the development of an integrated route network, with the holding of panel meetings starting in 1980, but with limited results, considering the complexity of the subject and the limited time available for the studies. It was only in 1999, during the Third CAR/SAM Air Navigation Meeting (CAR/SAM/3 RAN - Buenos Aires, Argentina, 5-15 October 1999) that the ATS route network was considered stable and fit to be a part of the Regional Air Navigation Plan.

Generally speaking, the development of the route network in the SAM Region was always based on the specific requirements of isolated routes; there was no global analysis that considered broader operational requirements, and in which a functional interrelationship among the various elements of airspace structure were sought, such as: ATS Routes, Control Sectors, Control Areas, TMAs, etc.

As already mentioned, the work performed by the States with the support of Regional Project RLA/98/ resulted in the implementation of 77 RNAV routes, the modification of the paths of 58 routes, and the elimination of only 7 routes. Although this effort has met the operational requirements of airspace users, the addition of RNAV routes to the existing airspace structure ended up, in some cases, by increasing airspace complexity and thus reducing ATC capacity.

3.2. Use of Performance-Based Navigation

RNAV-5 application in the South American Region, foreseen for November 2010, will create the necessary conditions for harmonising aircraft and operator approval criteria for flights in RNAV routes and will provide the necessary elements for establishing adequate spacing between routes.

According to conclusion SAM/IG/2- 3, the assessment of fleet navigation capacity will make it possible to analyse the feasibility of implementing an exclusive RNAV-5 airspace in the SAM Region in a given volume of airspace (for example, between FL 290 and FL 410). This exclusionary airspace would constitute an important element for reducing airspace complexity, with the corresponding increase in airspace capacity.

Another important aspect to be considered is that the maintenance of conventional routes in the SAM Region should take into account the coverage of available radio aids, so that they can be effectively flown by aircraft not equipped for RNAV operations.

3.3. Regional and Domestic Routes

The SAM route network has always been planned and implemented on an isolated basis. International routes are normally analysed in an international forum like the RNAV/RNP Task Force, the ATM/CNS Subgroup, AP/ATM meetings, etc., individually, without any specific concern for an integrated analysis based on the need to assess the impact on ATC capacity. States are responsible for domestic routes, which are implemented without any specific integration into the regional route network. In light of the interrelationship between domestic and regional routes, planning and implementation should be integrated, with a view towards obtaining an optimum structure of the airspace, including ATC control sectors.

SAM ATS routes should be implemented using a top-down strategy, in order to identify the main regional air traffic flows, as well as the shortcomings in the route network and in the sectorisation of the ATC units involved. Based on that identification, it would be possible to conceive an integrated regional/national network that would meet the needs of airspace users and ATS providers. That network should consider the need for sectorisation, integration of the airports it does not serve, the use of non-permanent routes, and connectivity among TMAs.

3.4. Relationship between ATS Routes and Control Areas (CTAs)

According to the information contained in the CAR/SAM Regional Air Navigation Plan (Doc. 8733), six States in the SAM Region have adopted widespread use of CTAs in their airspace above and beyond the ATS routes. Nonetheless, in a significant portion, air traffic control service is not provided to flights that are occasionally made outside the ATS routes. As a result, ATS routes must be established to serve IFR flights, even though the air traffic flow may not be significant, in order to guarantee that they receive air traffic control service.

More widespread adoption of CTAs in the SAM Region could avoid the need for implementing ATS routes in significantly less dense air traffic flows.

3.5. Flexible Use of Airspace (FUA)

In the SAM Region, there is no systematic and harmonised application of a Flexible Use of Airspace, unlike EUROCONTROL. There is a close relationship between FUA application and ATFM, inasmuch as the adoption of non-permanent routes can increase airspace capacity in a given portion of the airspace.

The expansion and systematic application of FUA in the SAM Region is a key element for optimising the route network, in view of its importance for ensuring, at least partially, that aircraft fly their optimum profiles and, in some cases, that airspace complexity is reduced.

Note the need for full development of documentation concerning FUA application, including standards and procedures, as well as the harmonised publication of special procedures applied to non-permanent routes, as provided for in Doc 8126.

3.6. Protected Airspace – Route Spacing Concept

The protected airspace and RNAV route spacing concept envisaged in Annex 11 was not defined in the SAM Region. As a result, spacing between RNAV routes, one of the key elements of airspace planning, has not yet been established, leaving controllers to apply vertical and/or horizontal separation based on ATS Surveillance.

One of the most important factors in optimising the route network would be to establish minimum spacing between RNAV routes, based on the specific characteristics of the SAM Region, such as air traffic volume, air traffic concentration, passing frequency, operational errors, available ATS surveillance, aeronautical communications, and ATC intervention capacity, etc.

Airspace complexity is intrinsically related to the need for controller intervention to provide aircraft separation. The more “natural” the separation between aircraft, ensured by appropriate spacing between ATS routes, the less the need for controller intervention and, consequently, the greater the available ATC capacity.

3.7. **Harmonised route network publication**

As already mentioned in item 3.5, there is a need to harmonise the way special procedures established for non-permanent routes are published, as required by Doc. 8126. That harmonisation will enable aircraft operators to find out about the operating restrictions on the use of those routes, particularly if they can be used for flight planning and when they can be used for that purpose. Likewise, the restrictions could also establish specific fuel requirements in the event that more appropriate routes were not available.

3.8. **Planning Principles**

The planning principles should be applied in order to make an objective analysis based on statistical data and the experience of State experts, in order to remedy shortcomings in the route network and in the sectorisation of the ATC units involved.

Collection and analysis of flight data in a significant time sample is key to planning route optimisation, considering that it will be possible through that data to determine the main air traffic flows and, as a result, to prioritise the implementation of routes designed to serve those flows, thereby establishing the most direct routes possible for most flights. Collection of that data has always been limited, thus preventing an in-depth analysis of the main air traffic flows.

Data collection by CARSAMMA, which is limited to the airspace between FL 290 and FL 410 (sample used in RVSM safety assessment), is normally applied, allowing for a preliminary analysis, considering that data are not available for all SAM States. The data obtained from CARSAMMA, processed and analysed in the PBN Implementation Programme for En route Operations, approved by Conclusion SAM/IG/2-1, were inserted in the table. A preliminary analysis of that data reveals that in most of the SAM FIRs, considering the States for which data are available, a small number of ATS routes (up to 14) are used by a large number of flights (85% or more). Table 2, for its part, shows that a small number of city-pairs (up to 16) accounts for most of the air traffic movement (51% or more) in the FIRs.

Air traffic movement between FL 290 and FL 410, by FIR, and percentage of flights on the main ATS Routes Period: 13 to 28 January 2008				
Country	**FIR**	**Amount of air traffic in the sample**	**Percentage of flights on the main ATS routes**	**Number of ATS Routes**
Argentina	Cordoba	1769	92%	13
	Comodoro Rivadavia	713	96%	9
Bolivia	La Paz	684	97%	13
Brazil	Amazonica	4085	67%	13
	Brasilia	11333	50%	12
	Curitiba	10499	44%	13
	Recife	3418	66%	13
	Sao Paulo (TMA)*	1911	100%	4
Chile	Antofagasta	1480	89%	10
	Pascua	164	100%	4
	Puerto Montt	412	94%	6
	Punta Arenas**	281	98%	7
	Santiago	2109	89%	13
Guyana	Georgetown	187	97%	9
Panama	Panama	1389	70%	14
Paraguay	Asuncion	605	90%	14
Peru	Lima	3599	69%	14
Suriname	Paramaribo	369	98%	11
Uruguay	Montevideo***	892	100%	12

* Provides ACC service in the segment between Rio de Janeiro and Sao Paulo. This sample does not cover a significant volume of flights because the aircraft fly below FL 290.
** 91% on ATS UT 100 route
*** A significant volume of flights does not appear in the sample because the aircraft fly below FL 290.

Table 1 – Air Traffic Movement between FL 290 and FL 410, by FIR, and percentage of flights on the main ATS Routes

Air traffic movement between FL 290 and FL 410, by FIR, and percentage in the main city-pairs Period: 13 to 28 January 2008				
Country	**FIR**	**Amount of air traffic in the sample**	**Percentage of flights of the sample in the main city-pairs**	**Number of city-pairs**
Argentina	Cordoba	1769	51%	14
	Comodoro Rivadavia	713	65%	13
Bolivia	La Paz	684	60%	14
Brazil	Amazonica	4085	27%	14
	Brasilia	11333	28%	17
	Curitiba	10499	28%	16
	Recife	3418	31%	16
	Sao Paulo (TMA)*	1911	76%	15
Chile	Antofagasta	1480	70%	15
	Pascua	164	89%	11
	Puerto Montt	412	94%	10
	Punta Arenas**	281	92%	8
	Santiago	2109	58%	13
Guyana	Georgetown	187	79%	10
Panama	Panama	1389	48%	15
Paraguay	Asuncion	605	53%	13
Peru	Lima	3599	39%	16
Suriname	Paramaribo	369	71%	15
Uruguay	Montevideo**	892	75%	11

* Provides ACC Service in the segment between Rio de Janeiro and Sao Paulo. A significant volume of flights is not covered in the sample because the aircraft fly below FL 290.

** A significant volume of flights is not covered in the sample because the aircarft fly below FL 290

Table 2 – Air Traffic Movement between FL 290 and FL 410, by FIR, and percentage in the main city-pairs

Another important planning phase is the consideration, at the beginning of the work, of airspace sectorisation under ATS unit jurisdiction, inasmuch as the route network has a decisive influence on the sectors and, *vice versa*, the latter can influence the composition of the route network. Route network and ATC planning are not integrated in the SAM Region. In the more complex airspaces, airspace modeling and ATC simulation (in real and/or fast time) tools need to be applied to assess the interrelationship between the route network and airspace sectorisation.

Another analysis that is needed is the integration of the route network and TMA arrival/departure paths (SIDs and STARs), considering that RNAV promotes conditions for the establishment of specific arrival/departure sectors, thereby reducing airspace complexity. It can be noted that most SAM States have not yet implemented the necessary SIDs and STARs to link up departure/arrival paths with the route network. It is important to consider those procedures during the route network planning phase.

3.9. **Concepts that facilitate implementation of the Route Network**

Of the concepts mentioned in item 2.9, the CAR/SAM Regions have already implemented RVSM in January 2005. RNAV-5 implementation, foreseen for November 2010, will contribute enormously to the optimisation of the SAM route network. As already mentioned in item 3.5, there is a need to systematise FUA application in the Region, as a means for optimising use of the available airspace. In addition, the planning of airspace in general and of the new route network in particular, should consider the seamless concept in order to achieve a better airspace structure. As a result, the conception of a new SAM route network should not consider FIR and sector boundaries for its development.

3.10. **Planning Techniques**

From the available information, it is not possible to identify whether the planning techniques mentioned in item 2.10 are being applied. Nevertheless, the use of one-way routes can be noted in the following TMAs, indicating the possibility that specialised arrival and departure routes and sectors are being used:

a) Argentina: Ezeiza

b) Brazil: Belo Horizonte, Brasilia, Rio de Janeiro, and Sao Paulo.

c) Chile: Santiago

d) Uruguay: Montevideo.

In optimising the route network, it would be important to assess the specific operational requirements of the main TMAs, in order to identify the need for specialised arrival and departure sectors. Should the TMAs need such, it would be necessary to establish points of entry and departure, in order to allow for the development and integration of the route network into the structure of the main TMAs of the SAM Region. It would also be necessary to evaluate whether that integration would be accomplished by means of the route network or through SIDs/STARs linking the main airports to trunk routes that would serve the main regional flows.

4. Implementation Phases

The SAM route network should be optimised in phases, in order to achieve the corresponding operational benefits as early as possible. The concept of route network versions would be incorporated starting in phase 2, considering that the airspace structure is changing in keeping with the growth in air traffic movement, the shift in air traffic demand from one Region or airport to another, and the available technology, among other aspects. The use of route network versions reflects the need for their periodic comprehensive revision, in order to always guarantee the best possible airspace structure. The implementation phases, with their corresponding activities, are set forth in the Programme for Optimising the ATS Route Network of the South American Region that is presented as Attachment A to this programme. This chapter describes the activities listed in Attachment A.

4.1. Phase 1 – RNAV-5 Implementation

It is advisable to consider RNAV-5 implementation as the beginning of the route network optimisation programme, keeping in mind that it is a concept that will facilitate that optimisation. That implementation phase will be carried out in keeping with the SAM PBN Implementation Programme, approved by the SAM/IG/2 meeting and which is based on the PBN Roadmap approved by GREPECAS.

4.2. Phase 2 – Implementation of Version 1 of the SAM ATS Route Network

The second phase would correspond to the first version of the SAM ATS route network, within a new integrated development concept. This new version should consist of a broader analysis of the route network, based on statistical data about air traffic movement and fleet navigation capacity, seeking the elimination of unused routes and the exclusion or reduced use of "conventional" routes in a volume of airspace yet to be determined, in which a significant majority of users are equipped for RNAV-5 operations. That phase is directly related to phase 1 and a significant portion of the part relating to the Airspace Concept, envisaged in the RNAV-5 Implementation Programme in the SAM Region, would be detailed during said phase of the Route Network Optimisation Programme. It would be desirable for phases 1 and 2 to be implemented at the same time. Inasmuch as that may not be possible, given the complexity of the route network studies, this programme will maintain two separate phases.

4.2.1. Draft the Feasibility Study for Optimising the SAM Route Network

This activity aimed at assessing the feasibility of optimising the route network, the strategy to be used, and the proposal of a detailed action plan to accomplish said optimisation, is part of the study carried out.

4.2.2. Airspace Concept

The development of the Airspace Concept is the basis for optimising the route network, inasmuch as that concept is fundamental for instituting measurable benefits for airspace users. In that connection, the necessary analyses for the development of that concept should be based on statistical data about air traffic movement and the capacity of the aircraft fleet operating in the SAM Region.

4.2.2.1. Collect traffic data in order to understand airspace traffic flows

Statistical data are essential for shaping an airspace structure that conforms to the airspace planning principles and techniques presented in items 2.8 and 2.10 of this programme, respectively. Traffic data should be collected periodically in order to analyse the evolution of air traffic demand in the Region. According to the discussions held by the SAM/IG meetings, the SAM States should use the form presented in Attachment B, to collect the necessary data for developing version 1 of the SAM route network. It is essential for States to fill in the form according to the instructions given, in order to ensure that the data are consistent and effectively used in the analysis, as well as to facilitate their processing.

4.2.2.2. Analyse the Fleet Navigation Capacity

The Fleet Navigation Capacity is necessary to determine the airspace volume in which it is possible to apply RNAV on an exclusionary basis, in order to optimise aircraft flow and, at the same time, reduce the complexity and the pilot and air traffic controller workload. This task corresponds to task 1.3 of the SAM RNAV-5 Implementation Programme and should be completed in 2009.

4.2.2.3. Determine the gateways of the main TMAs in the SAM Region

States should present their National PBN Implementation Plans, as foreseen in Resolution 36/23 of the 36th ICAO Assembly and in Conclusion 15/38 of GREPECAS/15. States should develop their own airspace concepts for PBN planning and implementation in the TMAs. This will lead them to define the gateways for the main TMAs in the SAM Region. In version 1 of the route network, it will only be possible to have TMA gateways for the States that have already undertaken their PBN implementation process or any other way to restructure airspace in the TMAs. Furthermore, the information available from the States in developing version 1 should also be considered in this phase.

4.2.2.4. Determine and obtain the necessary tools for conducting the study mentioned in item 4.2.2.5 (aeronautical charts, specific software)

The detailed study specified in item 2.2.5 of the Action Plan for Phase 2 calls for specific tools, like aeronautical charts and specific software, to permit an adequate analysis of the SAM route network. Such tools will also be necessary for the workshop envisaged in item 2.2.6 of the same action plan. In this way, Regional Project RLA/06/901, with the support of the SAM/IG/3 meeting, shall determine these tools and seek the means to obtain them. Generally speaking, it will be necessary to have aeronautical charts containing the route network, the main TMAs, the SIDs and STARs and the approach procedures of the main airports in the SAM Region. It would also be advisable to use flight planning software like, for example, FliteStar (Jeppesen), containing the information mentioned in the aeronautical charts, in order to facilitate information management. Furthermore, it would be advisable to use software that would allow for the design of new routes, with the automatic determination of approximate geographic coordinates of significant points.

4.2.2.5. Conduct a detailed study of the SAM ATS route network, with a view to preparing version 1 of the route network

Considering the complexity of the task of developing a new version of the route network for the SAM Region, it will be necessary for a group of experts to be assigned to prepare a preliminary version containing all of the relevant information, permitting experts of each SAM State to evaluate it, for purposes of reviewing and validating the study. The main aim of version 1 of the SAM route network will be to minimise airspace complexity through the elimination of ATS routes not being used, and the elimination of "conventional" routes in an appropriate volume of airspace. The study should also seek to integrate regional and domestic routes, including proposals for the elimination and/or realignment of domestic routes, to be considered by the States involved. It is important to stress that the determination of the interface points between the CAR and SAM Regions will be of key importance for guaranteeing the interoperability of the route networks of the two Regions. It will also be possible in that phase to obtain operational advantages from realigning ATS routes to serve TMA gateways of States that already possess that information.

The study should develop a proposed preliminary amendment to the CAR/SAM Air Navigation Plan. It will also be necessary for the study to establish the required safety assessment methodology, in accordance with the magnitude of the proposed changes and of the need to determine the spacing between RNAV-5 routes in the SAM Region. The SAM/IG/5 Meeting should review the complete study in order to seek a version in keeping with the planning of the States involved.

4.2.2.6. Hold a workshop of SAM experts to review and validate the study referred to in item 4.2.2.5.

The SAM States should review and validate the work described in item 4.2.2.5, including proposals for the elimination and/or realignment of domestic routes. The most rapid and effective way of performing that review and validation would be through a workshop where the responsible experts could present the work done, in the necessary detail for an appropriate evaluation. The State experts could use the same tools used for the study, thereby facilitating its understanding. It is expected that the experts participating in the workshop will have the authority to decide on the implementation of the route network, using the same model applied in the AP/ATM meetings.

4.2.3. Implementation of Version 1 of the SAM ATS Route Network

The SAM Regional Office and the States are responsible for the activities of this item, in terms of processing the proposed amendment to the CAR/SAM Air Navigation Plan and publishing version 1 of the SAM ATS Route Network, respectively. The dates for the implementation activities will be established in keeping with the complexity of the amendments proposed to the study mentioned in 4.2.2.5 and decided in the workshop mentioned in 4.2.2.6.

4.3. Phase 3 – Implementation of Version 2 of the SAM ATS Route Network

The third phase would correspond to version 2 of the SAM ATS route network and should consist of the complete restructuring of the route network in a search for complete integration between ATS routes, control sectors, TMAs, etc., applying the Flexible Use of Airspace concept. This phase would require specific airspace modeling and ATC fast-time simulation tools.

4.3.1. Flexible Use of Airspace

As already mentioned in items 2.9 and 3.5, Flexible Use of Airspace is one of the concepts that facilitates optimisation of the route network and that is not being systematically applied in the SAM Region. Inasmuch as the various implementation projects existing in the Region would not permit this subject to be addressed in version 1 of the SAM route network, an FUA application model would be established for version 2 of the route network.

4.3.1.1. Develop Guidance Material for Application of the Flexible Use of Airspace Concept

FUA application depends upon the development of appropriate guidance material, from which States may obtain, in a harmonised way, all of the procedures applicable at regional level. An example of FUA application is that carried out by EUROCONTROL, which can be obtained from the EUROCONTROL Handbook for Airspace Management (ASM.ET1.ST08.54000.HBK02-00), at its website address: http://www.eurocontrol.int/airspace/gallery/content/public/documents/fua/EUROCONTROL%20ASM%20HBK%20Ed2-A05%20-%20Released%20Issue%20140308.pdf. Other EUROCONTROL guidance documents can be obtained at the following web address: http://www.eurocontrol.int/airspace/public/site_preferences/display_library_list_public.html. This initial guidance material should be limited to basic FUA application, considering the lack of specific tools for airspace management (ASM) in real time. In general terms, that application would be based on the use of routes similar to those used by EUROCONTROL as CDR 1 and CDR 3. The CDR 2s depend upon the cited ASM tools that shall not be available for version 2 of the route network.

The guidance material should include, *inter alia*, the following aspects:

- Model for the use of non-permanent routes, similar to that applied by EUROCONTROL (Conditional Routes – CDR).
- Criteria for defining scenarios in which non-permanent routes are applied.
- Criteria for categorising non-permanent routes.
- Harmonised publication of non-permanent routes.
- Representation of non-permanent routes in aeronautical charts.

4.3.1.2. Establish a Civil-Military Coordination Committee to evaluate application of the Flexible Use of Airspace Concept

To ensure FUA application, each State should create a Civil/Military Coordination Committee to evaluate the opportunities for using the Special Use Airspaces (SUA). It is important to stress that the success of this initiative will depend on the power of the committee to guarantee airspace use to all users, according to their specific needs, while avoiding, inasmuch as possible, the permanent reservation of airspace that would lead to the waste of airspace whenever it is not being used.

4.3.1.3. Develop proposals for route implementation and/or realignment, in keeping with the use of FUA

Based on the flexible use of airspace achieved through the Civil-Military Coordination Committee, State airspace planners should develop route implementation or realignment proposals that would have a significant impact on the development of version 2 of the route network, bearing in mind opportunities for offering users better flight profiles and a possible reduction in airspace complexity.

4.3.2. Airspace Concept

The general methodology used for version 1 and described in item 4.2.2. should be used to develop the airspace concept for version 2 of the route network. The items below will describe only the particular elements to be applied in the development of version 2.

4.3.2.1. Collect traffic data to understand airspace traffic flows

It is important to stress that States should develop a methodology for routine data collection to permit appropriate airspace planning and also the verification of an increase and/or shift in air traffic demand that would require a change in the existing airspace structure.

4.3.2.2. Analyse Fleet Navigation Capacity

In the same way mentioned in item 4.3.2.1 for data collection, States are expected to implement a permanent fleet navigation capacity analysis system to assess the extent of the airspace volume where RNAV-5 would be applied on an exclusionary basis, and to enable the evolution foreseen in the PBN Roadmap for the medium term (RNP-2).

4.3.2.3. Determine the gateways of the main TMAs in the SAM Region

The gateways of the main TMAs in the SAM Region may evolve in accordance with systematic application of FUA and progress in PBN implementation in TMAs and approaches.

4.3.2.4. Determine and obtain the necessary tools for conducting the study mentioned in item 4.3.3.5 (aeronautical charts, specific software)

Continuous evaluation of the tools available for developing the route network is necessary, in order to obtain the most appropriate material to ensure an effective and efficiency work.

4.3.2.5. Make a detailed study of the SAM ATS route network, with a view to developing version 2 of the route network

The development of version 2 of the route network will require a more in-depth analysis, considering that. in addition to the route network itself, the study should also include other aspects, like control sectors, TMA interface, etc. In this sense, and in view of the complexity of version 2, the main objective of the study is to propose scenarios that can be evaluated through the use of airspace modelling and fast-time simulation tools. Such scenarios would be the various options for version 2 of the route network, which would require objective data in order to select the best implementation option, considering the metrics defined in the study, such as fuel consumption, CO^2 emissions, the number of aircraft crossings, etc.

4.3.2.6. Conduct studies of Airspace Modeling and Fast-Time Simulation

Based on the study carried out in 4.3.2.5, Airspace Modeling and Fast-Time Simulation studies should be conducted in order to obtain the necessary data for the analysis to be made by State experts, permitting a decision to be taken regarding the option to be implemented.

4.3.2.7. Hold a workshop among experts from SAM States

Based on the studies mentioned in items 4.3.2.5 and 4.3.2.6, State experts shall review and validate the option of version 2 of the route network to be implemented.

The study should develop a preliminary proposal of amendment to the CAR/SAM Air Navigation Plan. It will still be necessary for the study to establish the required safety assessment methodology, in keeping with extent of the proposed changes and the need to determine RNAV-5 route spacing in the SAM Region. The SAM/IG/9 should review the complete study in order to seek a version that is in line with the planning of the States involved.

4.3.2.8. Implementation of Version 2 of the SAM ATS Route Network

The SAM Regional Office and the States are responsible for the activities under this item, in terms of processing the proposed amendment to the CAR/SAM Air Navigation Plan and publishing version 2 of the SAM ATS Route Network, respectively. The dates for the implementation activities will be established in accordance with the complexity of the modifications proposed in the studies mentioned in 4.3.2.5 and 4.3.2.6 and determined in the workshop mentioned in item 4.3.2.7.

ATTACHMENT 1 TO APPENDIX B

PROGRAMME FOR OPTIMISING THE ATS ROUTE NETWORK IN THE SOUTH AMERICAN REGION (GPIs 1, 5, 7, 8, 10, 11)

Activity	Start	End	Responsible party	Observations
1. **Phase One – RNAV-5 Implementation**				
1.1. RNAV-5 implementation in the SAM Region	**Apr 2008**	**Nov 2010**	**Regional Project RLA/06/901**	The implementation will be carried out according to the Implementation Programme approved at the SAM/IG/2 meeting
2. **Phase Two – Implementation of Version 1 of the SAM ATS Route Network**				
Activity	**Start**	**End**	**Responsible party**	**Observations**
2.1. Conduct a Feasibility Study for Optimising the SAM Route Network	March 2009	Apr 2009	Regional Project RLA/06/901	
2.2. Airspace Concept				
2.2.1 Collect traffic data to understand air traffic flows	June 2008	SAM/IG/4	SAM/PBN/IG (Project RLA/06/901) States	Task 1.2 of the RNAV-5 Implementation Project The Secretariat shall send request to States for data collection using the form contained in Appendix C to the Report on Agenda Item 2, in Excel format.
2.2.2 Analyse the fleet navigation capacity	June 2008	SAM/IG/4	SAM/PBN/IG (Projects RLA/06/901	Task 1.3 of the RNAV-5 Implementation Project

			and RLA/99/901) States IATA	
2.2.3 Determine the gateways of the main TMAs in the SAM Region	SAM/IG/3	SAM/IG/4	States	
2.2.4 Determine and obtain the necessary tools to make the study mentioned in item 2.2.5 (aeronautical charts, specific software)	SAM/IG/3	SAM/IG/4	SAM/PBN/IG (Project RLA/06/901)	Flight Star.(Verify if the acquisition of another software is necessary)
2.2.5 Make a detailed study of the SAM ATS route network, with a view to preparing version 1 of the route network, including the following: • Indicate the domestic and international ATS routes that should be eliminated, in accordance with their use; • Propose the volume of exclusionary airspace for RNAV-5 application • Indicate the "conventional" RNAV routes that should be eliminated or replaced by RNAV routes in the exclusionary RNAV-5 airspace. • Indicate the RNAV routes that should be realigned, in accordance with the gateways of the main SAM TMAs (see 2.2.3). • Describe in detail the proposed new SAM route network, based on the analysis of the aforementioned items. • Describe in detail the interface between the SAM route network and the CAR route network. • Propose the initial draft Proposal of Amendment to the CAR/SAM ANP	SAM/IG/4	March 2010	SAM/PBN/IG (Project RLA/06/901)	Three persons for a period of 3 weeks. IATA and operators would be invited to select one person to assist in the development of this task.
2.2.6 Prepare safety assessment required, applying a qualitative methodology through the use of SMS	April 2010	May 2010	Project RLA/06/901	One person two weeks

2.2.7 Hold the Workshop of Experts from the SAM States to review and validate the study made under item 2.2.5.	SAM/IG/5	June 2010	SAM/PBN/IG (Project RLA/06/901) States	Further to SAM/IG/5
2.3 Implementation of Version 1 of the SAM ATS Route Network				
2.3.1 Process the proposal of amendment to the CAR/SAM Air Navigation Plan	TBD		SAM Regional Office	Shall depend on the decisions to be adopted by the routes workshop of 2.2.6
2.3.2 Publish version 1 of the SAM ATS Route Network	TBD		States	Shall depend on the decisions adopted in the routes workshop of 2.2.6.
2.3.3 Entry into effect of version 1 of the SAM ATS Route Network	TBD			
3. **Phase Three – Implementation of Version 2 of the SAM ATS Route Network**				
Activity	**Start**	**End**	**Responsible party**	**Observations**
3.1. **Flexible Use of Airspace**				
3.1.1. Develop guidance material for the application of the Flexible Use of Airspace concept, including: • Model for using non-permanent routes similar to that applied in EUROCONTROL (Conditional Routes – CDR). • Criterion for defining scenarios in which non-permanent routes are applied • Criterion for categorising non-permanent routes • Harmonised publication of non-permanent routes • Representation of non-permanent routes in aeronautical charts	SAM/IG/5	SAM/IG/6	SAM/PBN/IG (Project RLA/06/901)	

3.1.2. Establish the Civil-Military Coordination Committee to evaluate application of the Flexible Use of Airspace concept mentioned in 3.1.1.	SAM/IG/6	SAM/IG/7	States	The Civil/Military Committees should be implemented in those States which have not done so. Plan Civil/Military Meeting/Workshop in 2011.
3.1.3. Develop proposals for route implementation and/or realignment, in keeping with the utilisation of FUA	SAM/IG/6	SAM/IG/7	States	See 3.1.2
3.2. **Airspace Concept**				
3.2.1. Collect traffic data to understand air traffic flows	SAM/IG/6	SAM/IG/7	SAM/PBN/IG (Project RLA/06/901) States	
3.2.2. Analyse the fleet navigation capacity	SAM/IG/6	SAM/IG/7	SAM/PBN/IG (Projects RLA/06/901 and RLA/99/901) States IATA	
3.2.3. Determine the gateways of the main TMAs in the SAM Region	SAM/IG/6	SAM/IG/7	States	
3.2.4. Determine the necessary tools for making the study mentioned in item 3.2.5 (aeronautical charts, specific software)	SAM/IG/6	SAM/IG/7	SAM/PBN/IG (Project RLA/06/901)	
3.2.5. Make a detailed study of the SAM ATS route network with a view to developing version 2 of the route network, including: • Definition of scenarios for the SAM airspace structure, including ATS routes, control sectors, TMA interface, for assessment using airspace modelling and fast-time ATC simulation tools. • Indicate the ATS routes that should be eliminated in accordance with their utilisation; • Propose, if necessary, the extent of	SAM/IG/7	June 2011	SAM/PBN/IG (Project RLA/06/901)	

exclusionary airspace volume for RNAV-5 application • Indicate, as necessary, the "conventional" ATS routes that should be eliminated or replaced by RNAV routes in accordance with the possible extension of the exclusive RNAV-5 airspace volume. • Indicate the RNAV routes that should be realigned in keeping with possible modifications to the gateways of the main TMAs in the SAM Region. • Detail possible scenarios for version 2 of the SAM route network and of control sectors, based on the analysis of the previous items • Detail the interface between the SAM route network and the CAR route network • Propose the initial draft Proposal of Amendment to the CAR/SAM ANP. • Define the required safety assessment (qualitative or quantitative).				
3.2.6. Prepare a safety assessment and routes spacing	SAM/IG/7	July 2011	CARSAMMA	Quantitative assessment in order to determine spacing between routes to be applied in item 3.2.5
3.2.7. Make Airspace Modelling and Fast-Time Simulation studies to assess the scenarios developed in 3.2.5	August 2011	SAM/IG/9		
3.2.8. Hold the Workshop of Experts from the SAM States to review and validate the studies made in items 3.2.5 and 3.2.6.	SAM/IG/9	June 2012	Project RLA/06/901 States	
3.3. **Implementation of Version 2 of the SAM ATS Route Network**				
3.3.1. Process the proposal of amendment to the CAR/SAM Air Navigation Plan	TBD		SAM Regional Office	

3.3.2.	Publish version 1 of the SAM ATS Route Network	TBD	States	
3.3.3.	Entry into effect of version 2 of the SAM ATS Route Network	TBD		

RECOPILACIÓN DE DATOS DE LOS VUELOS REALIZADOS EN EL ESPACIO AEREO SUPERIOR DE LA REGION SAM (FL 245 - UNL)

CAMPOS OBLIGATORIOS													CAMPOS CONDICIONALES						
IDENTIFICACIÓN DE LA FIR:													PROGRESIÓN EN ESPACIO AÉREO SUPERIOR						
FECHA	DISTINTIVO DE LLAMADA	REGISTRO DE LA AERONAVE	TIPO DE ACFT	AD DE ORIGEN	AD DE DESTINO	FIJO DE ENTRADA EN EL ESPACIO AÉREO SUP.	HORA EN EL FIJO DE ENTRADA	FL EN EL FIJO DE ENTRADA	AEROVIA EN EL FIJO DE ENTRADA	FIJO DE SALIDA EN EL ESPACIO AÉREO SUP.	HORA EN EL FIJO DE SALIDA	FL EN EL FIJO DE SALIDA	FIJO 1	HORA EN EL FIJO 1	FL EN EL FIJO 1	FIJO 2	HORA EN EL FIJO 2	FL EN EL FIJO 2	CONTINUAR SI ES NECESARIO

ORIENTACIONES PARA LLENAR EL FORMULARIO
DE RECOPILACIÓN DE DATOS

1- Introducción

Este formulario se dirige a colecta de datos, con el objetivo de obtener una muestra del movimiento de tránsito aéreo en el espacio aéreo superior de la Región SAM (FL 245-UNL).
El formulario debe ser confeccionado en formato de planilla "EXCEL" y llenado de forma que todos los eventos (movimientos de tránsito aéreo) de todos los días del período solicitado estén dispuestos cronológicamente y en un único formulario, o sea, en una única planilla "EXCEL" (sin líneas o espacio en blanco, o títulos intermediarios).
Todos los campos en esta planilla deben ser llenados obligatoriamente, excepto los campos contenidos en el intervalo titulado "Campos Opcionales" que solo deberán ser llenados si haya cualquier cambio de nivel de vuelo o de ruta.
Ejemplos:

CAMPOS OBLIGATORIOS												**CAMPOS OPCIONALES**							
IDENTIFICACION DE LA FIR:												**PROGRESIÓN EN ESPACIO AÉREO SUPERIOR**							
FECHA	INDICATIVO LLAMADA DE AERONAVE	TIPO DE ACFT	AD DE ORIGEN	AD DE DESTINO	FIJO DE ENTRADA EN EL ESPACIO AÉREO SUP.	HORA EN EL FIJO DE ENTRADA	FL EN EL FIJO DE ENTRADA	AEROVIA EN EL FIJO DE ENTRADA	FIJO DE SALIDA EN EL ESPACIO AÉREO SUP.	HORA EN EL FIJO DE SALIDA	FL EN EL FIJO DE SALIDA	FIJO 1	HORA EN EL FIJO 1	FL EN EL FIJO 1	FIJO 2	HORA EN EL FIJO 2	FL EN EL FIJO 2	CONTINUAR SI ES NECESARIO	
01/09/03	PTLPN	C550	SBBH	SBBR	VURKI	12:20	250	UW12	IMEDI	12:29	330								**adjunto: ejemplo 1**
01/09/03	GLO1713	B737	SBRF	SBGL	NUQ	19:30	390	UW60	PONGA	20:12	390								**adjunto: ejemplo 2**
01/09/03	ARG1303	B747	KMIA	SAEZ	ELAKA	9:45	370	UT410/UA30	ISOPO	10:47	370	CERES	10:40	370					**adjunto: ejemplo 4**
02/09/03	TAM8097	A332	LFPG	SBGR	KAKUD	7:29	390	UG741	MENDS	8:33	390	MCL	7:35	390					
...	...	...	...	...	...	...	...	...	...	...	...								
...	....	...	...	...	...	...	...	...	...	...	...								
18/09/03	IBE6824	A340	SBGR	LEMD	BGC	20:06	290	UW13	RIGEL	21:10	370	COTON	20:40	330	CNF	20:54	370		**adjunto: ejemplo 4**
...	...	...	...	...	...	...	...	...	...	...	...								
...	...	...	...	...	...	...	...	...	...	...	...								
30/09/03	PTSAC	E135	SBCG	SBEG	TOSAR	10:57	350	UW28	RAPAT	11:41	470								**adjunto: ejemplo 3**

La muestra de los datos debe corresponder al movimiento diario de tránsito aéreo comprendido entre el FL 245 a ilimitado (UNL), en el período solicitado, por FIR y en todas las rutas de la FIR.

2 - Campos Obligatorios

• Línea 18: Campo "Identificación de la FIR"

Deberá ser llenado conforme el designador ICAO contenido en el Doc.7910.
Ejemplo: SBBS, SLLF, SAEU.

• **Columna A :Campo "Fecha"**

Deberá ser llenado apenas con caracteres numéricos de la manera siguiente: dd/mm/aa.
Ejemplo: para el día 01 de febrero de 2003 llene 01/02/03.

• **Columna B: Campo "Código de Llamada de la Aeronave"**

Deberá ser llenado con el máximo siete caracteres alfanuméricos, sin espacios, o guiones.
Ejemplos: AAL906, PTLCN, VRG8764.

• **Columna C: Campo "Tipo de Aeronave"**

Deberá ser llenado conforme el designador ICAO contenido en el Doc. 8643.
Ejemplos: para el Airbus A320-211 llene A320;
para el Boeing B747-438 llene B744.

• **Columna D: Campo "Aeródromo de Origen"**

Deberá ser llenado conforme el designador ICAO contenido en el Doc.7910.
Ejemplos: SBGR, SCEL, SAEZ.

• **Columna E: Campo "Aeródromo de Destino"**

Deberá ser llenado conforme el designador ICAO contenido en el Doc.7910.
Ejemplos: SKBO, MPTO, SEQU.

• **Columna F: Campo "Fijo de Entrada en el Espacio Aéreo Superior"**

Deberá ser llenado con el máximo cinco caracteres alfabéticos, relativos al fijo de entrada en el espacio aéreo correspondiente.
Ejemplos: UGADI, ILURI, BAQ
RMK: Para vuelos ascendiendo en espacio superior sin cruzar límite de FIR, el fijo de entrada será el fijo anterior al primer fijo que la aeronave pasa nivelada.

• **Columna G: Campo "Hora en el Fijo de Entrada"**

Deberá ser llenado con caracteres numéricos de la siguiente forma: hh:mm.
Ejemplos: para 01hora y 09 minutos llene las 01:09;
para 12 horas y 23 minutos llene 12:23.

• **Columna H: Campo "Nivel de Vuelo en el Fijo de Entrada"**

Deberá ser llenado con tres caracteres numéricos, correspondiendo al nivel de vuelo en el fijo de entrada del espacio aéreo superior.
Ejemplo: para el FL 250 llene 250;
para FL430 llene 430.

• Columna I: Campo "Ruta en el fijo de entrada"

Deberá ser llenado con el máximo 5 caracteres alfanuméricos, sin espacios, o guiones.
Ejemplos: UA301, UB689, UW20, UW7
RMK: Cuando durante el vuelo la aeronave cambia de ruta dentro de espacio aéreo superior, la nueva ruta debe informarse después de la primera ruta separada por el caracter "/ ".
Ejemplo: UL302/UW650.

• Columna J: Campo "Fijo de Salida del Espacio Aéreo Superior"

Deberá ser llenado con el máximo cinco caracteres alfabéticos, relativo al fijo de salida del espacio aéreo correspondiente.
RMK: Este fijo será, normalmente, el de límite de FIR, o el último fijo cruzado por la aeronave en vuelo nivelado.
Ejemplos: INTOL, NIKON, CARPA.

• Columna K: Campo "Hora en el Fijo de Salida"

Deberá ser llenado con caracteres numéricos de la manera siguiente: hh:mm.
Ejemplos: para 08 horas y 07 minutos llene las 08:07;
para 00 hora y 48 minutos llene las 00:48

• Columna L: Campo "Nivel de Vuelo en el Fijo de Salida"

Deberá ser llenado con tres caracteres numéricos, correspondiendo al nivel de vuelo en el fijo de salida del espacio aéreo superior.
Ejemplo: Para el FL330 llene 330; para el FL 350 llene 350.

3 - Campos Opcionales (Progresión del vuelo en el Espacio Aéreo)

• Columna M: Campo "Fijo 1"

Deberá ser llenado con el máximo 5 caracteres alfanuméricos, relativo al fijo donde hubo alteración de nivel de vuelo o de ruta.
Observación: Este fijo será el último fijo que aeronave pasó nivelada.
Ejemplos: POKON, KUBEK, BAQ.

• Columna N: Campo "Hora en el Fijo 1"

Deberá ser llenado con caracteres numéricos de la siguiente forma: hh:mm.
Ejemplos: para 10horas y 05 minutos llene las 10:05,
para 12 horas y 23 minutos llene 12:23.

• Columna O: Campo "Nivel de Vuelo en el Fijo 1"

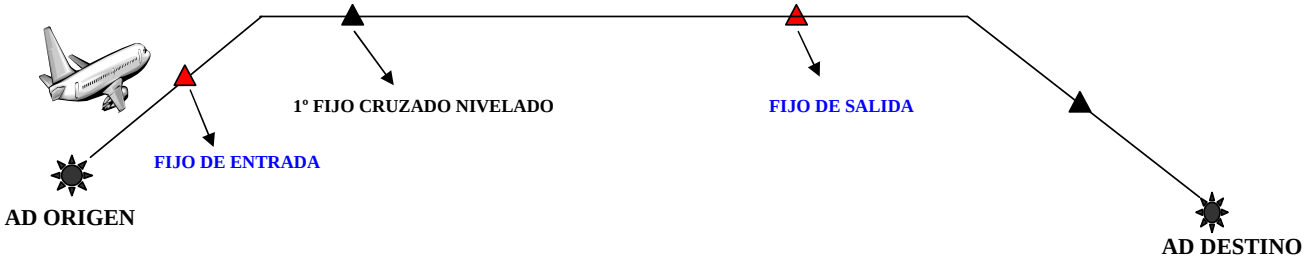
Deberá ser llenado con tres caracteres numéricos, correspondiendo al nivel de vuelo en el fijo nº 1.

Ejemplo: para el FL370 llene 370;
para el FL410 llene 410.

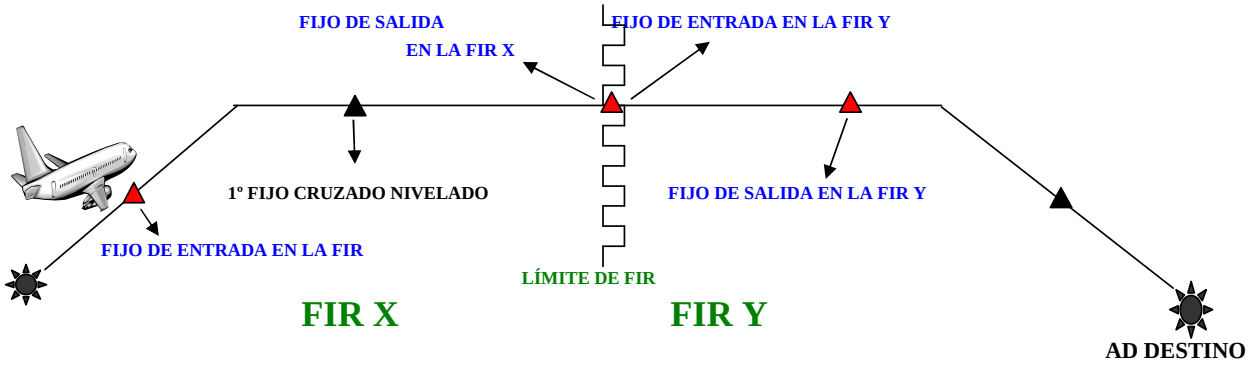
Nota: En el caso de más de una alteración de nivel de vuelo y/o aerovía, llenar tantos campos de fijo/hora/nivel de vuelo cuántos son necesarios.

ADJUNTO

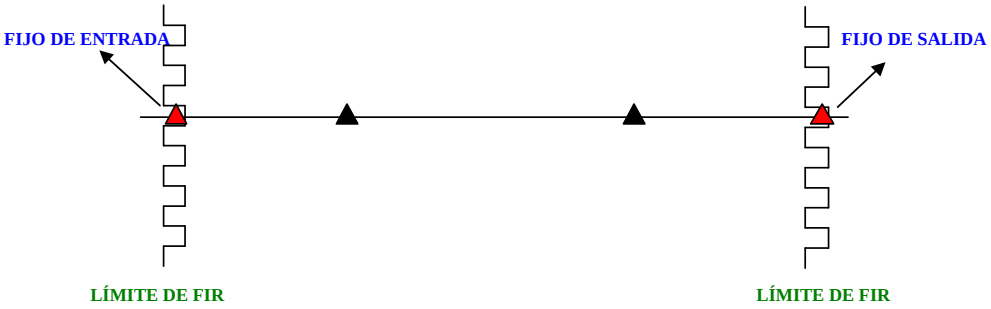
Ejemplo 1: Vuelo con origen y destino en la misma FIR.



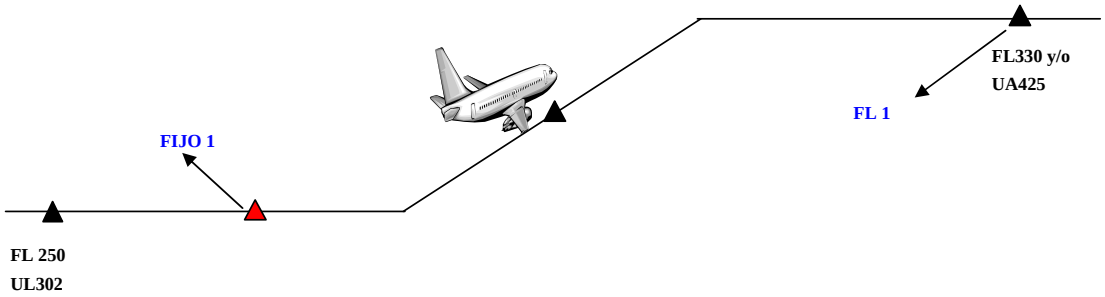
Ejemplo 2: Vuelo con origen y destino en FIR diferentes.



Ejemplo 3: Vuelo cruzando límites de FIR.



Ejemplo 4: Vuelo con cambio de FL y/o AWY (Campos OPCIONALES)



Agenda Item 3: Implementation of performance-based navigation (PBN) in the SAM Region

En-Route PBN Action Plan (RNAV5)

3.1 The Meeting recalled that Conclusion SAM/IG/1 - *CAR/SAM PBN Roadmap*, was formulated during SAM/IG/01 Meeting, which indicates that ICAO SAM States, working in RNAV/RNP implementation, take the pertinent actions in order to follow guidelines contained in the CAR/SAM PBN Roadmap.

3.2 It was also of the opinion that States must prepare their own PBN implementation plans including regional planning, as shown in the roadmap. These national implementation plans should count, among other matters, with the action plans, and include activities related, dates and responsible persons for each activity.

3.3 SAM/IG/2 Meeting, on the other hand, examined PBN Implementation Project – Short Term En-route operations for the SAM Region and the associated PBN en-route regional action plan (RNAV 5), introduced the changes deemed pertinent, established responsible persons and start/end dates for different activities and adopted it as guidance material to be followed by States.

3.4 In view that the PBN en route action plan (RNAV-5) considers tasks in charge of previously defined responsible persons, with established compliance dates, tasks compliance status designated to each one of them by the Implementation Group, were revised so as to follow up.

3.5 After the revision, the meeting concluded that:

a) Item 1.4 – Analyse communication, navigation (VOR, DME) means and surveillance in land to meet navigation specifications and the way of navigation reversion. This task should be presented by project RLA/06/901 in SAM/IG/4 Meeting.

b) Optimize air space structure, reorganizing the network or implementing new routes based in strategic objectives of air space concept, considering ATC “airspace modelling” simulations (accelerated time and/or actual time), on line tests, etc. - This task will be carried out under optimization program of SAM routes network.

c) Assessment of the Safety - taking into account that RNAV-5 implementation will not have significant changes in present airspace structure of SAM Region, assessment of safety should be based in a qualitative analysis, through the use of SMS.

d) Item 5.1 – Assess PBN implementation in ATC automated systems, considering the amendment 1 to the PANS/ATM (FPLSG). This task was considered finished, considering that changes in the automated systems do not constitute a requirement for the implementation of RNAV-5. Also, this task will be developed by GREPECAS Subgroup CNS/ATM.

e) Item 5.2 – Implement the necessary changes in ATC automated systems – considering that the changes do not constitute a requirement for the RNAV-5 implementation, this task was eliminated.

f) Item 6.2 – Publish national regulations in order to implement RNAV-5 navigation specification – States regulations area still in process of publication. The task should be completed before SAM/IG/4. Consequently, the beginning of tasks 6.3 and 6.4 was postponed for SAM/IG/4.

3.6 The Meeting agreed that the following tasks should be developed by Project RLA/06/901 during 2010:

a) Prepare a performance measurement plan, including gas emission, safety, efficiency, etc.

b) Develop the safety assessment, applying a qualitative methodology, through the use of SMS.

c) Develop the AIP Supplement Model with applicable rules and procedures contents, including corresponding flight contingencies.

d) Develop amendments to regional documentation, if necessary.

e) Develop a training and documentation program for air traffic controllers and AIS exploiters.

f) Develop a post-implementation monitoring program of operations in route.

3.7 The result of the revision of RNAV 5 Action Plan is shown in **Appendix A** to this part of the Report.

National Plans for PBN Implementation

3.8 The Meeting recalled that GREPECAS/15, according to Resolution 36/23 of the 36a ICAO Meeting, approved the conclusion 15/38, which encourage the States and CAR/SAM Territories to:

a) Develop their PBN implementation national plans for December 2009 and present them to corresponding Regional Offices.

b) Consider the use of PBN action plan models developed by GREPECAS PBN task group; and

c) Designate a focal point which will coordinate the PBN implementation activities in each State/Territory.

3.9 The Meeting considered convenient that the PBN implementation national plans, which should be presented in December 2009 to SAM Regional Office, be presented in SAM/IG/4 Meeting, in order to allow the harmonisation of said plans in the South American Region. Likewise, the Meeting took note that ICAO PBN website contains a PBN Implementation Plan Model available to States. In this sense, the Meeting formulated the following conclusion:

Conclusion SAM/IG/3-3 PBN Implementation National Plans

That States of ICAO South American Region, present their PBN Implementation National Plans to SAM/IG/4 Meeting, using PBN Implementation Plan Model, shown in **Appendix B** of this part of the Report, as well as using the action plan models and information contained PBN Implementation Project TMA Operations and Short Term Approximations of SAM Region, approved by SAM/IG/2 Meeting.

Design of Instrumental Procedures Courses

3.10 The Meeting took note of future design of instrumental procedures courses RNAV/RNP and RNP AR APCH that will be carried out in the Region. When reading the PBN implementation program in TMAs and approximations, the Meeting was of the opinion that the Project RLA/06/901 should schedule a Course of APV BaroVNAV design of procedures for the first semester of 2010 and invite SAM States to participate and sponsor the attendance of project members.

AIS-AIM Migration

3.11 The Meeting recalled that during World Congress of Aeronautical Information Services (Madrid, 2006), a definition of a transition strategy from AIS (Aeronautical Information Service) to AIM (Aeronautical Information Management) was started, due to new requirements to provide a complete aeronautical information timely, with adequate quality and based, mainly in the new ATM concepts (Air Traffic Management).

3.12 The Meeting was of the opinion that ATM depends on pertinent, precise, quality and timely information available, to allow decision making fully aware. Those decisions should be adopted based in a process of Collaboration Decision Making (CDM), and not isolated. When shared by all the system and when using the adequate technologic advances, this type of information will allow the ATM participants to develop their activities and operations in a profitable and efficient way.

3.13 In this sense, SAM Region States are dedicated to corresponding investigation in order to meet these new requirements set out. In specific case of PBN implementation, AIS quality guarantee and validity of data base of navigation systems are of relevant importance, taking into account that flight in a PBN environment is based in said data base. Consequently, the Meeting was of the opinion that not all of the States are in same level of transition, for which, and in order to meet the new requirements, civil aviation authorities of the Region, that still have not performed them, should give high priority to the application of SARPS of Attachments 4 and 15, and particularly to the ones related to the 1984- Global Geodetics System (WGS-84) and with the AIS quality and automation management implementation, fundamental aspects to start the AIM transition.

3.14 With respect to navigation systems data base management, the Meeting considered necessary a better knowledge of the requirements established by ARINC 424, taking into account that RNAV and RNP procedures require the publication in AIP of the path terminators described therein. In this sense, ARINC offered the possibility to add a module about this subject in future training courses related to design of instrumental procedures RNAV/RNP and RNP AR APCH, which will be given in the Region. Due that some States of the Region have detected discrepancies among AIP publications and in information contained in data bases, the Meeting agreed that providers of these data bases should be invited to participate in SAM/IG/4 Meeting.

Common Reference Systems

3.15 Regarding this item, the Meeting considered relevant that States perform the contents of Appendix 4 – Aeronautic Letters, Chapter 2, Section 2.18 – Common Reference Systems 2.18.1 – Horizontal Reference Systems, and 2.182 – Vertical Reference Systems.

3.16 This last section was specially mentioned, indicating that reference to medium sea level (MSL) which provides the altitude list (elevations) related to the gravity with regard to a surface known as geoid, will be used as vertical reference system. In this sense, also it was recalled that the geoid at a worldwide level is approaching very closely to the medium sea level (MSL).

3.17 As per its definition, the equipotential surface in the earth gravity field coincides with the unaltered MSL, which extends in a continuous way through the continents. The elevations related to the gravity are also denominated orthometric elevations and the distance of points above ellipsoid, are denominated ellipsoidal elevations.

WGS-84 Horizontal Reference System

3.18 States have prepared their own geodetic references which usually differ from those of adjacent States. As requirements increased regarding the determination of distances further than national boundaries, new requirements emerged at a continental scale, as regards differences.

3.19 Observing the current situation in a route environment, the use of aids for ground-based navigation, with different reference frameworks, does not influence in a significant manner, since primary means for navigation, continue to be the signals of VOR or NDB, which define radial tracks to or from the radio beacon, with the turn points either in the beacon or to a distance determined by the DME.

3.20 In such circumstances, the coordinates published of the navigation aid do not influence in the aircraft track. However, this will dramatically change either in approach phase or landing phase or when reduced lateral separation between aircraft is applied; i.e., RNAV and RNP systems which present more strict precision and integrity requirements. Therefore, these discrepancies may not be tolerated and demand the introduction of a common geodetic reference system in civil aviation.

3.21 In view of the above, the body in charge of the aeronautical information service of States issues in its AIS publication, and also in its maps and electronically keeps in its databases, when applicable, the values of geographical coordinates and the vertical component, based on WGS-84.

3.22 To date, States have made great efforts for the implementation of such system, and even so, the full use of the geodetic system by States has not been concreted. Taking into consideration such situation and keeping in mind that it is of utmost importance that the WGS-84 is the geodetic system to work with values of geographical coordinates and the vertical component, it is necessary to establish which the real situation in these matters is. For this purpose, ICAO Secretariat made a query about the implementation status of WGS84 System, which was analyzed and updated by the Meeting. In **Appendix C** to this part of the Report, the obtained implementation status is shown.

Activities carried out by the Brazilian Administration for PBN Implementation

3.23 The Meeting took note that, bearing in mind the guidance provided by GREPECAS and SAM/IG meetings, the Brazilian Administration has initiated actions to implement PBN in the TMAs and Approach, as described in the following paragraphs.

Implementation Projects in the Brasilia/Recife and Rio de Janeiro/São Paulo TMAs

3.24 The National PBN Implementation Plan requested by GREPECAS in Conclusion 15/38 is in development process. In the meantime, a PBN Implementation Project for the Brasilia and Recife TMAs was developed, and is attached in **Appendix D** to this part of the Report. The project was based on the action plan approved by the SAM/IG/2 meeting. The PBN implementation project for the Rio and Sao Paulo TMAs is in the final phase of development, with a tentative implementation date of November 2010.

3.25 The objective of the PBN implementation project for the Brasilia/Recife TMAs, in addition to the implementation of PBN per se, is to gain experience in less complex, medium- to low-density airspaces, characterised by the Brasilia and Recife TMAs, respectively.

3.26 The Rio and Sao Paulo TMA implementation project is aimed at implementing PBN in the two of the main TMAs of Brazil in terms of airspace density and complexity. Furthermore, the short distance between the two TMAs (200 NM) and the inter-connection of air traffic flows between them, made it necessary to develop the implementation project to ensure the harmonisation of airspace structure and IFR procedures between the two TMAs.

Fast-time Simulation of the Brasilia TMA

3.27 The Meeting noted that fast-time simulation of the Brasilia and Recife TMAs started in December 2008, with a view to comparing three basic scenarios:

a) Current scenario (baseline) – to be used for comparison purposes;

b) Scenario 1 - with SID/STAR procedures as direct as possible, and

Implementation of Baro/VNAV RNP APCH procedures, RNAV/ILS approach procedures, and (GNSS) RNAV IFR departure procedures

3.28 Taking into account the benefits of early implementation of Baro/VNAV RNP APCH and RNAV/ILS approach procedures, as well as (GNSS) RNAV IFR departure procedures, the Brazilian Administration developed a project for the implementation of these procedures in 28 Brazilian airports in a 2-year period. The first procedures shall be published in August 2009. At the end of the 2-year period foreseen for full implementation, 256 IFR procedures will have been developed, of which 76 will be Baro/VNAV RNP APCH IAC, 40 RNAV (GNSS)/ILS IAC, and 140 (GNSS) RNAV SIDs.

3.29 One of the difficulties encountered in the development of the new IFR procedures involves the requirements of item 5.6.4 of Doc 8168 OPS/611 (PANS-OPS), concerning the visual segment surface (VSS). Since 15 March 2007, the new procedures should be protected from obstacles in the visual segment, defined by the VSS, or if they penetrate the VSS, an approach procedure should not be issued without an aeronautical study. Procedures published prior to 15 March 2007 shall have VSS protection following the periodical review, no later than 15 March 2012.

3.30 When developing BARO/VNAV RNP APCH procedures for the Vitoria and Belo Horizonte airports, the procedure designers involved encountered obstacles penetrating the VSS. In the case of the Vitoria airport, it will be possible to remove the obstacles, bearing in mind that they are artificial obstacles related to public lighting. In the case of Belo Horizonte, natural obstacles (hills around the airport) penetrate the VSS. The analyses made to date have shown that even if the descent slope/angle is increased to the allowed limit, it will not be possible to implement approach procedures unless the threshold is significantly displaced.

GNSS AIC

3.31 As foreseen in the Action Plans for En-route, TMA, and Approach Operations, the Administration has assessed the regulations for GNSS implementation as a means of navigation and has concluded that a complete reformulation is needed, based on the requirements established in the PBN Manual for RNAV-5 (en-route), RNAV-1 (TMA), RNP APCH, and Baro-VNAV RNP APCH.

3.32 For information purposes, the new GNSS AIC, in its Portuguese and English versions, published on 09/04/2009, is contained in **Appendix E** to this part of the Report.

RNAV-5 AIC

3.33 As foreseen in item 7.4 of the RNAV-5 Action Plan, the Brazilian Administration published the RNAV-5 AIC on 09/04/2009, pursuant to Conclusion SAM/IG/2-2.

Changes in ATC Automation Systems

3.34 Brazilian Administration has started studies related to changes to be applied in ATC automated systems, that will result in the insertion of alpha-numeric characters in flight progress strips and in the targets in radar screen, according to information contained in **Appendix F** to this part of the Report. The Meeting gave thanks for the information provided by Brazil and reiterated the need to harmonise the presentation of the national PBN implementation plans mentioned in GREPECAS Conclusion 15/38, as well as the use of PBN focal points in order to perform this activity in the Region, homogeneously.

Monitoring of the ABAS based Air Navigation Operations Performance

3.35 The Meeting took note that GNSS based air navigation operations require systems verifying the integrity of the signal in space in the global positioning systems (GPS). In this regard, to guarantee the GPS signal's in space integrity parameters, for en-route, non precision approach and terminal area ABAS based air navigation operations, there is a GPS receiver with a Receiver Autonomous Integrity Monitoring (RAIM) system.

3.36 An aircraft equipped with certified GPS receivers with RAIM (TSO C129a, E/TSO-C146) comply with the monitoring of the precision, integrity and continuity parameters specified in Annex 10, Vol. I, Table 3.7.2.4.1 – *Signal in space performance requirements*, for en-route, terminal en-route and non precision approach operations.

3.37 For the monitoring of the performance parameters indicated in the above paragraph, some air navigation services providers have taken under consideration the implementation of an independent ground in real time monitoring system. In this respect, many States have enquired regarding the need or not of implenting these type of systems, taking into consideration the functions of RAIM.

3.38 With the aim of providing guidance to States on ABAS based air navigation operations performance monitoring, the ICAO Air Navigation Commission (ANC) requested the Air Navigation Bureau (ANB) to elaborate a clarifying note on the subject, considering that the monitoring requirements regarding the status of the air navigation aids, including GNSS, are found in Annex 10, Volume I.

3.39 The note was prepared and presented to the ANC, which considered that same be included in the ICAO web page, under the PBN Section (www2.icao.int/en/pbn). The **Appendix G** to this part of the Report presents the information elaborated accordingly.

RAIM Prediction

3.40 The Meeting, when discussing the item referred to the ABAS performance monitoring, also observed the need to analyze the RAIM prediction capacity . This capacity must consider the GPS satellite spaces that are not covered, but known and foreseen, or other results in navigation system sensors. The appliance of said functionality depends on navigation specification that is applied in a specific airspace portion. The RAIM availability prediction should take into account the last ads addressed to air pilots (NOTAMs NANU published by NOAA) referred to GPS constellation and use an algorithm equal to same used in the equipment on board, or an algorithm based in presumptions for a RAIM prediction, to provide a more-conservative result. The RAIM availability usually is confirmed, using a specific model of RAIM prediction software.

3.41 In the particular case of United States airspace, i.e., FAA RAIM prediction website: www.raimprediction.net is applied. In Europe, website http://augur.ecacnav.com/augur/app/home, is applied. In this sense, the Meeting considered that RLA/06/901 should present information in SAM/IG/4 about the need to apply similar websites in SAM Region, as well as the corresponding analysis referred to the coverage of said services, considering the experience at a worldwide level.

3.42 Taking into account the NOTAM issuance requirements referred to GPS constellation status, the Meeting considered the need that Secretariat present detailed information on such requirements in SAM/IG/4, in order that States have clear information about the implementation of these requirements to meet the navigation specifications shown in the PBN CAR/SAM Route Map.

APPENDIX A

SHORT-TERM EN-ROUTE PBN ACTION PLAN (RNAV-5)
(GPIs 1, 4, 5, 7, 8, 10, 11, 12, 16, 21, 23)

1.	**Airspace concept**	**Start**	**End**	**Responsible party**	**Remarks**
1.1	Establish and prioritize strategic objectives (safety, capacity, environment, etc.)	June/2008	SAM/IG/2	SAM/PBN/IG (Project RLA/06/901)	Completed
1.2	Collect traffic data in order to understand traffic flows in a given airspace	June/2008	SAM/IG/4	SAM/PBN/IG (Project RLA/06/901)	In process
1.3	Analyze the navigation capacity of the aircraft fleet	June/2008	SAM/IG/4	SAM/PBN/IG (Projects RLA/06/901 and RLA/99/901) States IATA	In process. Survey sent to States
1.4	Analyze ground-based means of communication, navigation (VOR, DME) and surveillance to meet navigation specifications and the navigation reversal mode	June/2008	SAM/IG/3	SAM/PBN/IG (Projects RLA/06/901 and RLA/99/901) States	In process
1.5	Optimize airspace structure, reorganizing the network or implementing new routes based on the strategic objectives of the airspace concept, taking into account airspace modelling, ATC simulations (fast time and/or real time), live tests, etc.	SAM/IG/2	SAM/IG/4	SAM/PBN/IG (Project RLA/06/901) States IATA	Initial study presented in WP/04

2.	**Develop a performance measurement plan**	**Start**	**End**	**Responsible party**	**Remarks**
2.1	Draft a plan to measure performance, including gas emissions, safety, efficiency, etc.	SAM/IG/2	SAM/IG/5	SAM/PBN/IG Project RLA/06/901	In process

2.	**Develop a performance measurement plan**	**Start**	**End**	**Responsible party**	**Remarks**
2.2	Implement the performance measurement plan	Nov/2010	Permanent	SAM/PBN/IG (Project RLA/06/901) States IATA	No activity has been initiated

3	**Safety assessment**	**Start**	**End**	**Responsible party**	**Remarks**
3.1	Prepare safety assessment execution using a qualitative methodology through the application of SMS	SAM/IG/2	SAM/IG/5	CARSAMMA Project RLA/06/901 Regional Office	RLA/06/901 in order to provide guidance material to CARSAMMA The utilisation of qualitative methodology initially defined through the application of SMS processes

4	Establish a collaborative decision-making process (CDM)	Start	End	Responsible party	Remarks
4.1	Coordinate planning and implementation requirements with air navigation service providers, regulators, users, aircraft operators and military authorities	SAM/IG/2	SAM/IG/4	SAM/PBN/IG States	States have published an initial AIC
4.2	Establish the implementation date	SAM/IG/1	SAM/IG/4	SAM/PBN/IG States	States must analyse the feasibility of the tentative date in coordination with domestic operators and military authorities
4.3	Establish the documentation format in the SAM PBN website	SAM/IG/1	SAM/IG/2	SAM Regional Office	Completed
4.4	Report planning and implementation progress to the corresponding Regional Office. Conclusion to present national plans at SAM/IG/4	SAM/IG/2	SAM/IG/4	SAM/PBN/IG States	

5	ATC automated systems	Start	End	Responsible party	Remarks
5.1	Assess PBN implementation in ATC automated systems, taking into account amendment 1 to the PANS/ATM (FPLSG). Note: It is not a requirement for RNAV5 implementation	June/2008	SAM/IG/4	SAM/PBN/IG (Project RLA/06/901)	Completed According to the programme presented in ICAO guidelines (WP/09), it is not a requirement
5.2	Implement necessary changes in automated ATC systems	SAM/IG/2	TBD	States	Completed

6 Aircraft and operator approval		Start	End	Responsible party	Remarks
6.1	Analyze aircraft and operator approval requirements (pilots, dispatchers and maintenance personnel) in keeping with the PBN manual, and develop the necessary documentation.	June/2008	SAM/IG/2	Regional Project RLA/99/901-Regional Safety Oversight Cooperation System	Completed
6.2	Publish national regulations for the implementation of the RNAV-5 navigation specification	SAM/IG/2	SAM/IG/4	States	States should publish in October 2009
6.3	Begin the approval of aircraft and operators	SAM/IG/3	SAM/IG/5	States	
6.4	Establish and keep up to date a registry of approved aircraft and operators	SAM/IG/3	Permanent	CARSAMMA States Regional Office	Secretariat should send communication to CARSAMMA requesting data required for the registration data base
6.5	Verify the operation of the continuous monitoring programme (aircraft and procedures)	Nov/2010	Permanent	States	

7 Standards and procedures		Start	End	Responsible party	Remarks
7.1	Assess and, if applicable, publish the regulations on the use of GNSS.	June/2008	SAM/IG/2	SAM/PBN/IG (Project RLA/06/901) States	Completed
7.2	Finalize WGS-84 implementation	TBD	TBD	States	States which have not done so, should provide the information

7	Standards and procedures	Start	End	Responsible party	Remarks
7.3	Develop an AIC model to report PBN implementation plans	June/2008	SAM/IG/2	SAM/PBN/IG (Project RLA/06/901)	Completed
7.4	Publish the AIC reporting PBN implementation plans	SAM/IG/2	SAM/IG/4	States	States should publish on 9 April 2009
7.5	Develop an AIP Supplement model containing applicable standards and procedures, including the corresponding in-flight contingencies	SAM/IG/4	SAM/IG/5	SAM/PBN/IG (Project RLA/06/901)	
7.6	Publish the AIP Supplement containing applicable standards and procedures, including the corresponding in-flight contingencies	SAM/IG/5	SAM/IG/6	States	
7.7	Review the Procedural Handbook of the ATS units involved	SAM/IG/5	SAM/IG/6	States	
7.8	Update the letters of agreement between ATS units	SAM/IG/5	SAM/IG/6	States	
7.9	Develop an amendment to regional documentation, if necessary	SAM/IG/3	SAM/IG/4	SAM/PBN/IG (Project RLA/06/901)	
7.10	Submit a proposal of amendment to Doc. 7030, if necessary	SAM/IG/5	SAM/IG/6	SAM Regional Office	
7.11	Review practices and procedures to improve fuel consumption management and environmental protection	SAM/IG/1	Permanent	SAM/PBN/IG (Project RLA/06/901)	

8.	**Training**	**Start**	**End**	**Responsible party**	**Remarks**
8.1	Develop a training and documentation programme for operators (pilots, dispatchers and maintenance personnel)	SAM/IG/4	SAM/IG/5	Regional Project RLA/99/901	
8.2	Develop a training and documentation programme for air traffic controllers and AIS operators	SAM/IG/4	SAM/IG/5	SAM/PBN/IG (Project RLA/06/901)	
8.3	Develop a training programme for regulators (aviation safety inspectors)	SAM/IG/4	SAM/IG/5	RLA/99/901 States	
8.4	Conduct training programmes	SAM/IG/5	SAM/IG/6	States	
8.5	Conduct seminars for operators, explaining plans and expected operational and economic benefits	SAM/IG/1	SAM/IG/4	States	

9.	**Implementation decision**	**Start**	**End**	**Responsible party**	**Remarks**
9.1	Assess the available operational documentation (ATS, OPS/AIR)	July/2010	N/A	States	
9.2	Assess the percentage of aircraft and operators (non-exclusionary airspace)	July/2010	N/A	States	
9.3	Analyze the results of the safety assessment	July/2010	N/A	States	
9.4	Publish trigger NOTAM	Nov/2010	N/A	States	

10. Performance monitoring system	**Start**	**End**	**Responsible party**	**Remarks**
10.1 Develop a post-implementation en-route operations monitoring programme	SAM/IG/4	SAM/IG/5	SAM/PBN/IG (Project RLA/06/901)	
10.2 Implement a post-implementation en-route operations monitoring programme	Nov/2010	Nov/2011	States	
Pre-operational implementation date	Nov/2010	N/A		
Definitive implementation date	Nov/2011	N/A		

APPENDIX B

PBN Implementation Plan State X

Version 1

December 2009

About the Plan

ICAO Assembly Resolution A36-23 calls for each State to develop a national PBN implementation plan by 2009. This is a template developed by the ICAO PBN Programme, which has been adapted during SAM/IG/3 Meeting, as an example for use by the ICAO SAM States as they each must develop their own plans. This is only one example of what subjects a "National PBN Implementation Plan" that meets the intent of the resolution might contain. States are encouraged to tailor their plans to meet their needs. This may mean that the "PBN Implementation Plan" be not stand-alone, but part of a broader plan for development of aviation in the State. This is a determination that only the State can make. It should be pointed out that if the State has not yet met its obligations with regard to conversion to the WGS-84 coordinate system, this should be included in the plan, as all RNAV and RNP operations are conducted solely with reference to WGS-84 coordinates.

Guidance material for the presentation and complementation of ICAO National PBN Implementation Plans may be found in the CAR/SM PBN Roadmap and in Appendices B and E of the SAM/IG/2 Meeting Report on Agenda Item 2, which contain both guidance and PBN Action Plans for Approach and TMA developed during SAM/IG Meetings.

Why is a PBN implementation plan or roadmap needed?

After RVSM implementation on 20 January 2005, the main tool for the optimisation of the airspace structure is the Performance Based Navigation (PBN) implementation, which shall favour the necessary conditions for the RNAV and RNP capacity use of a significant portion of airspace users of the CAR/SAM Regions. Current planning of the Regional Planning and Implementation Groups is based on Air Navigation Plans and in Regional CNS/ATM Plans. These plans are currently made up basically of tables, which do not contain the necessary details for the implementation of each of the CNS and ATM elements.

The CAR/SAM PBN Roadmap was created for this reason. The necessary concurrent and follow-on step is to develop national plans that implement the regional plans at the State level and address PBN implementation strategy at the national level.

In view of the need for detailed navigation planning, the CAR/SAM Planning and Implementation Group (GREPECAS) deemed it advisable to call for preparation of a national PBN Implementation Plan by each State by December 2009, to provide proper guidance and direction to the domestic air navigation service provider(s), airspace operators and users, regulating agency, as well as foreign operators who operate or plan to operate in the State. This guidance should address the planned evolution of navigation, as one of the key systems supporting air traffic management, and describe the RNAV and RNP navigation applications that should be implemented in at least the short and medium term, in the State, using as guidance what is set up in the PBN Roadmap of the Region.

What are the objectives of the PBN Implementation Plan or Roadmap?

The PBN implementation plan should meet the following strategic objectives:

a) provide a high-level strategy for the evolution of the navigation applications to be implemented in the State in the short term (up to 2010) and medium term (2011-2015). This strategy is based on the concepts of PBN, Area Navigation (RNAV) and Required Navigation Performance (RNP), which will be applied to aircraft operations involving instrument approaches, standard departure (SID) routes, standard arrival (STAR) routes, and ATS routes in oceanic and continental areas in accordance with the implementation goals in the Assembly resolution;
b) ensure that the implementation of the navigation portion of the CNS/ATM system is based on clearly established operational requirements;
c) avoid unnecessarily imposing the mandate for multiple equipment on board or multiple systems on the ground;
d) avoid the need for multiple airworthiness and operational approvals for intra- and inter-regional operations;
e) prevent commercial interests from outdoing ATM operational requirements, generating unnecessary costs for the State as well as for airspace users.

What is the intent of the PBN Implementation Plan or Roadmap?

The PBN Implementation Plan should be developed by the State together with the stakeholders concerned and is intended to assist the main stakeholders of the aviation community plan a gradual transition to the RNAV and RNP concepts. The main stakeholders of the aeronautical community that benefit from this roadmap and should therefore be included in the development process are:

- Airspace operators and users
- Air navigation service providers
- Regulating agencies
- National and international organizations

The PBN Implementation Plan is intended to assist the main stakeholders of the aviation community plan the future transition and their investment strategies. For example, airlines and operators can use this roadmap to plan future equipage and additional navigation capability investments; air navigation service providers can plan a gradual transition for the evolving ground infrastructure. Regulating agencies will be able to anticipate and plan for the criteria that will be needed in the future as well as the future regulatory workload and associated training requirements for their work force.

What principles should be applied in development of the PBN Implementation Plan or Roadmap?

The implementation of PBN in the State should be based on the following principles:

a) Continued application of conventional air navigation procedures during the transition period, to guarantee availability by users that are not RNAV- and/or RNP-equipped;

b) Development of airspace concepts, applying airspace modelling tools as well as real-time and accelerated simulations, which identify the navigation applications that are compatible with the aforementioned concept;

c) Conduct of cost-benefit analyses to justify the implementation of the RNAV and/or RNP concepts in each particular airspace;

d) Conduct of pre- and post-implementation safety assessments to ensure the application and maintenance of the established target levels of safety.

e) Must not conflict with the regional PBN implementation plan.

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APÉNDICE C / APPENDIX C

SEGUIMIENTO DE LA IMPLANTACIÓN WGS/84 EN LA REGIÓN SAM / FOLLOW UP WGS/84 IMPLEMENTATION – SAM REGION

ESTADOS /STATES	ARG	BOL	BRA	CHI	COL	ECU	GUY	FGU	PAN	PAR	PER	SUR	URU	VEN
Parte I – Información General / Part I – General Information														
1. ¿Actualmente su administración dispone de una base de datos nacional que incluya información de coordenadas WGS-84? / Does your administration currently have a national database including information on WGS-84 coordinates?	Y	Y	Y*	*	Y	#	S/R	S/R	*	Y	Y*	S/R	Y	Y
2. ¿El método de levantamiento topográfico utilizado para calcular las coordenadas geográficas WGS-84 que garantice la precisión e integridad requerida se realizó con por lo menos tres estaciones de control para determinar los parámetros de referencia entre el marco de referencia local y el WGS-84? / Was the topographic method used to estimate WGS-84 coordinates to ensure accurateness and integrity required, made with at least three control stations to determine referential parameters in the local referential framework and the WGS-84?	Y En 8 AD	Y	*	Y*	N	Y	S/R	S/R	Y	Y*	Y	S/R	Y*	Y
Parte II – Coordenadas WGS84 de interés para la navegación aérea / Part II – WGS-84 coordinates of interest for air navigation														
Coordenadas de zonas/en ruta / Area coordinates/en-route														
1. Puntos en ruta ATS/RNAV / ATS/RNAV en-route fix	Y	Y	Y*	Y	Y	Y	S/R	S/R	Y	Y	Y	S/R	Y	Y
2. Puntos de referencia en ruta, /en-route reference fix	Y	Y	Y*	Y	Y	Y	S/R	S/R	Y	Y	Y	S/R	Y	Y
Punto de espera; y / Holding pattern Fixed; and	Y	Y	Y*	Y	Y	Y	S/R	S/R	Y	N/A	Y	S/R	Y	Y

ESTADOS /STATES	ARG	BOL	BRA	CHI	COL	ECU	GUY	FGU	PAN	PAR	PER	SUR	URU	VEN
puntos STAR/SID / STAR/SID fixed	Y	P	Y*	Y	Y	Y	S/R	S/R	Y	P	Y	S/R	Y	
3. Radioayuda para la navegación en ruta/ en-route radio navigation aids	Y	Y	Y*	Y	Y	Y	S/R	S/R	Y	Y	Y	S/R	Y	Y
4. Zonas restringidas/prohibidas/peligrosas Restricted/Prohibited/Dangerous areas	Y	Y	Y*	Y	Y	Y	S/R	S/R	Y	N	Y	S/R	Y	Y
5. Obstáculos en ruta/ En-route obstacles	N	Y	Y*	Y	Y	Y	S/R	S/R	Y	N/A	Y	S/R	Y	N/A
6. Limites de la FIR / FIR boundaries	Y	Y	Y*	Y	Y	Y	S/R	S/R	Y	Y	Y	S/R	Y	Y
7. Limites de CTA / CTA boundaries	Y	Y	Y*	Y	Y	Y	S/R	S/R	Y	Y	Y	S/R	Y	Y
CTZ	Y	Y	Y*	Y	Y	Y	S/R	S/R	Y	Y	Y	S/R	Y	Y
8.Otros puntos significativos que tengan relación con zonas / en ruta / Other significant points having relationship with en-route areas	Y	N	Y*	Y	Y	Y	S/R	S/R	Y	Y	Y	S/R	N	Y
Coordenadas de aeródromos/helipuerto / Aerodromes-heliport coordinates														
1. Puntos de referencia de aeródromo/ helipuerto / Aerodrome-heliport reference point	Y	Y	Y*	Y	Y	Y	S/R	S/R	**	Y **	Y	S/R	Y	Y
2. Umbrales de pista / Runway thresholds	Y	Y	Y*	Y	Y	Y	S/R	S/R	Y	Y	Y	S/R	Y	Y
3. Extremo de pista (punto de alineación de la trayectoria de vuelo)/ Runway end (flight trajectory alignment fix	Y	Y	Y*	Y	Y	Y	S/R	S/R	Y	Y	Y	S/R	Y	Y
4. Área de aproximación final y de despegue (FATO) / Approach and departure final area (FATO)	Y	N	Y*	N/A	Y	Y##	S/R	S/R	****	N	N/A	S/R	N/A	N/A

ESTADOS /STATES	ARG	BOL	BRA	CHI	COL	ECU	GUY	FGU	PAN	PAR	PER	SUR	URU	VEN
Umbrales de la FATO / FATO thresholds	Y	N	Y*	N/A	Y	Y##	S/R	S/R	*****	N	N/A	S/R	N/A	N/A
5. Radioayuda para la navegación en el área terminal/ radio navigation aids in terminal areas	Y	Y	Y*	Y	Y	Y	S/R	S/R	Y	Y	Y	S/R	Y	Y
6. Radioayuda situada en el aeródromo/helipuerto/ Radio navigation aids located in the aerodrome/heliport	Y	Y	Y*	Y	Y	Y	S/R	S/R	Y	Y	Y	S/R	Y	Y
7. Puntos FAF; /Fixed FAF	Y	Y	Y*	Y	Y	Y	S/R	S/R	**	Y ***	Y	S/R	Y	Y
FAP; y/FAP and	Y	Y	Y*	Y	Y	Y	S/R	S/R	**	Y ***	Y	S/R	Y	Y
otros IAP esenciales/Other Essential IAP	Y	Y	Y*	Y	Y	Y	S/R	S/R	**	Y ***	Y	S/R	Y	Y
8. Puntos en el eje de pista/ Runway centerline points	Y	N	Y*	Y	N	Y	S/R	S/R	N	N	Y	S/R	Y	Y
9. Puntos de eje de calle de rodaje/taxiway centerline points	N	N	Y*	Y	N	N	S/R	S/R	Y	N	N	S/R	Y	Y
10. Puntos de rodaje aéreo / air taxiing	N	N	Y*	N/A	N	N	S/R	S/R	N	N	N	S/R	N	Y
11. Puntos de vías de transito/air traffic points	N	N	Y*	N/A	N	N	S/R	S/R	N	N/A	N	S/R	Y	Y
12. Puestos de estacionamiento de aeronaves/Aircraft parking position	Y	P	Y*	Y	N	Y	S/R	S/R	Y	Y ****	Y	S/R	Y	Y
13. Punto de verificación INS /INS checking fix	N	P	Y*	Y	N	N	S/R	S/R	N	N	N	S/R	N	Y
14. Obstáculos en el área de circuito y en el aeródromo/helipuerto/ Obstacles in the circuit area and in the aerodrome-heliport	Y	P	Y*	Y	Y	Y	S/R	S/R	***	Y*	Y	S/R	Y	Y

ESTADOS /STATES	ARG	BOL	BRA	CHI	COL	ECU	GUY	FGU	PAN	PAR	PER	SUR	URU	VEN
15. Puntos de referencia y otros puntos esenciales para la aproximación final comprendido el procedimiento de aproximación por instrumentos/ Reference points and other Essentials fixes for final approach including instrument approach procedure	Y	Y	Y*	Y	Y	Y	S/R	S/R	**	Y	Y	S/R	Y	Y

Y = Yes/SI
* = Ver comentarios / See comments
N = No
P = Parcialmente / Partially
N/A = Not applicable / No aplicable
S/R = Without answer / sin respuesta

COMENTARIOS DE LOS ESTADOS / COMMENTS BY STATES

ESTADOS / STATES	COMENTARIOS / COMMENTS
ARGENTINA	Se dispone de base de datos WGS – 84 pero no es única, ya que hay una base de datos por AIP, otra para GIS, otra para obstáculos, etc, en resumen hay bases de datos pero no única./There is WGS-84 database but it is not unique, since there is a data base for AIP, another one for GIS, another for obstacle, summarizing, there are databases but it is not unique. *La información de coordenadas WGS-84 si bien se encuentra en formato digital, no está disponible en una base de datos nacional./ The information of WGS-84 coordinates, while being in digital format; it is not available in a national data base.
BOLIVIA	STARs no publicadas./ STARs not published.
BRAZIL	*** Parte I Número 2/Part I Number 2** – El sector responsable de la encuesta de operaciones topográficas utiliza una estación única de control para determinar los criterios de referencia entre ARP y WGS-84. Encuesta sobre geodésica topográfica con rastreador (doble frecuencia), sobre la cuenta N° 5 IBGE resolución de 1993.03.31. Esta resolución asegura la precisión de las coordenadas, de acuerdo con los SARPS de OACI. / The sector responsible for the topographic survey operations uses a single control station to determine the reference standards between the ARP and WGS-84. Topographic geodetic survey with tracker (Double frequency), on account Nº 5 IBGE resolution of 1993.03.31. This resolution assures the accuracy of the coordinates, in accordance with ICAO SARPS. ***Parte II Número 1 al 15/Part II Number 1 to 15** – La resolución es más protectora de lo recomendado. Nosotros ponemos atención a la precisión requerida en todos los puntos que hayan sido aplicados o en la gran mayoría de puntos que nosotros presentamos con precisión mayor a la prescrita por OACI en el Anexo 4 (Apn.6, tablas 1 al 5). / The resolution is more protective than recommended. We attend the required accuracy in all applied items or on the great majority of the items we present accuracy greater than the prescribed by ICAO Annex 4 (Appendix 6, tables 1 to 5).
CHILE	1. La información se encuentra en WGS-84, pero aún no existe una base de datos nacional consolidada/Information is in WGS-84 but there is not a consolidated national database yet. 2. Los levantamientos se han realizado en base a puntos pertenecientes a la red geodésica nacional del Instituto Geográfico Militar de Chile/Collection of information has been made base don points belonging to geodetical network from the Military Geographical Institute of Chile. 4, 10, 11 No se aplica, pero de ser necesario se pueden obtener en WGS-84 / 4, 10, 11, Not applicable but if necesary, they may be obtained in WGS-84.
COLOMBIA	Sin comentarios / No comment
ECUADOR	#Tenemos la información del levantamiento topográfico en WGS-84de aeródromos, radio-ayudas, obstáculos, rutas, etc. Los mismos que se encuentran almacenados en un archivo digital e impreso./We have the information of the topographical rising in WGS-84de aerodromes, radio-nav aids, obstacles, routes, etc. The same ones that is stored in a digital file and form. ##Los helipuertos nacionales la información que se publica en el AIP, no ha sido verificada su levantamiento en WGS-84/ The national heliports, the information that is published in the AIP, their rising has not been verified in WGS-84
GUYANA	S/R

ESTADOS / STATES	COMENTARIOS / COMMENTS
FRENCH GUYANA	S/R
PANAMA	*Tenemos la información de los levantamientos, no tenemos base de dato electrónica con la información. de los aeródromos./ We have the information on the collection, we do not have electronic database with the information on aerodromes ** puntos transformados en mesa, Programa GEOTRANS v2.2.5./points converted in GEOTRANS v2.2.5 programme *** son objeto de levantamiento los obstáculos dentro del aeropuerto./obstacles in the airport are subject to collection. **** los helipuertos nacionales el usuario proporciona las coordenadas WGS-84 y no podemos asegurar la integridad y precisión/national heliports. the user provides wgs-84 coordinates and we may not ensure integrity and accurateness.
PARAGUAY	* Levantamiento topográfico realizado por la DISERGEMIL./Topographic study made by DISERGEMIL ** las coordenadas se obtuvieron con GPS diferencial./Coordinates were obtained with differential GPS *DISERGEMIL: DIRECCION DEL SERVICIO GEOGRAFICO MILITAR *** PUNTOS OBTENIDOS MEDIANTE PROGRAMA IOPA 83 / OBTAINED WITH IOPA 83 PROGRAMME **** ESTACIONAMIENTO EN MANGA SOLAMENTE / PARKING ON FINGER ONLY
PERU	*Tenemos la información de los levantamientos, no tenemos base de dato electrónica con la información de los aeródromos./ We have the information on t he Collection, we do not have Electronic database with the information on aerodromes..
SURINAME	S/R
URUGUAY	Por los ajustes en la red Sudamericana SIRGAS se entiende conveniente actualizar los datos para la verificación In view of adjustments in SIRGAS South American network it is pertinent to update data for verification.
VENEZUELA	Sin comentarios / No comments

APPENDIX D

Project for PBN Implementation in the Brasilia and Recife TMAs

1 Airspace concept	**Start**	**End**	**Responsible party**	**Remarks**
1.1 Establish and prioritise strategic objectives (safety, capacity, environment, etc.)	15/12/08	31/03/09	States	
1.2 Collect traffic data in order to understand the traffic flows in TMA airspace	07/04/08	11/12/09	States	
1.3 Analyse the navigation capacity of the aircraft fleet in the TMA	03/11/08	30/11/09	States	
1.4 Analyse ground-based means of communication, navigation (VOR, DME), and surveillance to meet navigation specifications and navigation reversal mode	15/12/08	31/07/09	States	
1.5 Develop a new sectorisation of the Brasilia and Recife TMAs	17/03/09	30/04/09	States	
1.6 Develop SIDs, STARs, and approach procedures based on strategic objectives of the airspace concept	08/09/08	30/04/09	States	
1.7 Conduct fast-time simulations	26/03/09	28/08/09	States	
1.8 Conduct real-time simulations	26/03/09	28/08/09	States	
2. Develop a performance measuring plan			States	
2.1 Draft a plan to measure performance, including gas emissions, safety, efficiency, etc.	30/03/09	05/06/09	States	
2.2 Implement the performance measuring plan	01/03/10	01/03/11	States	
3 Safety assessment			States	
3.1 Determinar que metodología será usada para evaluar la seguridad en el espacio aéreo y espaciamiento de rutas, dependiendo de la especificación de navegación, considerando el “airspace modeling”, simulaciones ATC (tiempo fast-time and/or in real-time), live tests, etc.	02/03/09	29/05/09	States	
3.2 Develop a data collection programme to assess airspace safety	01/06/09	12/06/09	States	

3.3	Prepare the preliminary airspace safety assessment	15/06/09	31/07/09	States	
3.4	Prepare the final airspace safety assessment	03/08/09	30/10/09	States	
4	**Establish a collaborative decision-making process (CDM)**			States	
4.1	Coordinate planning and implementation requirements with air navigation service providers, regulators, users, aircraft operators, and military authorities	16/04/09	01/03/11	States	
4.2	Assess the tentative implementation date	02/11/09	27/11/09	States	
4.3	Define the documentation format at the DECEA PBN web site	26/05/08	20/06/08	States	
4.4	Report planning and implementation progress to the corresponding Regional Office	20/04/09	30/03/11	States	
5	**ATC automated systems**			States	
5.1	Assess PBN implementation in ATC automated systems, taking into account amendment 1 to the PANS/ATM (FPLSG).	09/02/09	03/04/09	States	
5.2	Implement the necessary changes in ATC automated systems	17/08/09	29/01/10	States	
6	**Aircraft and operator approval**			States	

6.1	Review aircraft and operator approval requirements (pilots, dispatchers, and maintenance personnel), as defined in the PBN Manual, and develop the necessary documentation.	08/10/08	30/04/09	States	
6.2	Publish national regulations for the implementation of the RNAV-1 navigation specification	01/05/09	19/06/09	States	
6.3	Begin the approval of aircraft and operators	22/06/09	01/03/10	States	
6.4	Establish and keep up to date a registry of approved aircraft and operators	22/06/09	01/03/10	States	
6.5	Verify the operation of the continuous monitoring programme (aircraft and procedures)	01/03/10	01/03/11	States	
7	**Standards and procedures**			States	
7.1	Assess and, if appropriate, publish the regulations on the use of GNSS	07/04/08	09/04/09	States	
7.2	Finalise WGS-84 implementation	03/08/09	14/08/09	States	
7.3	Ground validation and in-flight inspection of SIDs and/or STARs	05/10/09	06/11/09	States	
7.4	Establish the navigation database validation requirements and procedures	16/06/09	30/10/09	States	
7.5	Develop an AIC model to report PBN implementation plans	27/04/09	05/06/09	States	
7.6	Publish the AIC reporting on PBN implementation plans	08/06/09	10/08/09	States	
7.7	Develop the AIP Supplement model containing applicable standards and procedures, including the corresponding in-flight contingencies	17/08/09	16/10/09	States	
7.8	Publish the AIP Supplement containing applicable standards and procedures, including the corresponding in-flight contingencies	15/01/09	15/01/09	States	
7.9	Review the Procedural Handbook of the ATS units involved	19/10/09	18/12/09	States	
7.10	Update the letters of agreement between ATS units	19/10/09	18/12/09	States	
8	**Training**			States	

8.1	Develop a training programme and documentation for operators (pilots, dispatchers an maintenance personnel)	01/06/09	28/08/09	States	
8.2	Develop a training programme and documentation for air traffic controllers and AIS operators	19/10/09	18/12/09	States	
8.3	Develop a training programme for regulators (aviation safety inspectors)	19/10/09	18/12/09	States	
8.4	Conduct training programmes	31/08/09	26/03/10	States	
8.5	Conduct seminars for operators, explaining plans and expected operational and economic benefits	01/09/09	12/03/10	States	
9	**Implementation decision**			States	
9.1	Assess the available operational documentation (ATS, OPS/AIR)	26/01/09	30/01/09	States	
9.2	Assess the percentage of approved aircraft and operators (non-exclusionary airspace)	26/01/09	30/01/09	States	
9.3	Analyse safety assessment results	26/01/09	30/01/09	States	
9.4	Publish trigger NOTAM	20/03/09	23/03/09	States	
10	**Performance monitoring system**			States	
10.1	Develop a post-implementation monitoring programme for TMA operations	02/11/09	26/03/10	States	
10.2	Implement a post-implementation monitoring programme for TMA operations	26/03/10	31/03/11	States	
Pre-operational implementation date		08/04/10		States	
Definitive implementation date		08/04/11		States	

APPENDIX E

BRASIL **AIC**

DEPARTAMENTO DE CONTROLE DO ESPAÇO AÉREO **A**

DIVISÃO DE GERENCIAMENTO DE NAVEGAÇÃO AÉREA **08/09**

AV GENERAL JUSTO, 160 – 2º AND. - CASTELO

20021-130-RIO DE JANEIRO – RJ **09 ABR 2009**

TEL: 021 3814-8237 AFTN: SBRJYNYI ADM: PAME FAX: 021 2101-6252 TELEX: 2137113 COMAER BR

SISTEMA GLOBAL DE NAVEGAÇÃO POR SATÉLITES - GNSS

1 DISPOSIÇÕES PRELIMINARES

1.1 FINALIDADE

A presente Circular de Informações Aeronáuticas - AIC tem por finalidade estabelecer os critérios para utilização do Sistema Global de Navegação por Satélites – GNSS no espaço aéreo brasileiro.

1.2 ÂMBITO

As disposições estabelecidas nesta AIC aplicam-se a todos aqueles que, no decorrer de suas atividades, venham a utilizar o GNSS como meio de navegação aérea primário.

2 DISPOSIÇÕES GERAIS

2.1 A 10ª Conferência de Navegação Aérea, da Organização de Aviação Civil Internacional - OACI, realizada em 1991, endossou a concepção do sistema de Comunicações, Navegação, Vigilância/Gerência de Tráfego Aéreo - CNS/ATM, buscando o emprego de novas tecnologias disponíveis, de forma a propiciar um melhor gerenciamento do tráfego aéreo.

2.2 Com as primeiras iniciativas de implantação de sistemas CNS/ATM por alguns Estados e Grupos Regionais de Planejamento e Implementação (PIRG), observou-se à necessidade de se desenvolver um conceito completo, buscando um sistema ATM global integrado, atendendo a requisitos operacionais claramente estabelecidos. Este conceito formaria a base para a implantação coordenada das tecnologias CNS/ATM.

2.3 Em resposta às necessidades supracitadas, a Organização de Aviação Civil Internacional (OACI) elaborou o Conceito Operacional ATM Global, que foi aprovado pela 11ª Conferência de Navegação Aérea, e publicado como o Doc. 9854 AN/458.

BRASIL **AIC**

DEPARTAMENTO DE CONTROLE DO ESPAÇO AÉREO **A**

DIVISÃO DE GERENCIAMENTO DE NAVEGAÇÃO AÉREA **08/09**

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GLOBAL NAVIGATION SATELLITE SYSTEM – GNSS

1 PRELIMINARY GUIDELINES

1.1 PURPOSE

This Aeronautical Information Circular (AIC) has the purpose of establishing the criteria for use of the Global Navigation Satellite System (GNSS) within the Brazilian airspace.

1.2 SCOPE

The procedures established by this AIC are applied to all those who use the GNSS as the primary means of navigation.

2 GENERAL GUIDELINES

2.1 The 10th Air Navigation Conference of the International Civil Aviation Organization – ICAO, held on 1991, endorsed the concept of Communications, Navigation, Surveillance / Air Traffic Management System – CNS/ATM, considering the use of the new available technologies in order to achieve a better air traffic management.

2.2 After further development work of the implementation of the CNS / ATM system by some States and Planning and Implementation Regional Groups (PIRG), it was observed the need of a complete concept, moving towards an integrated global ATM system, in order to establish clear operational requirements. Such concept would be the basis for the coordinated implementation of the CNS / ATM technologies.

2.3 After analyzing the needs proposed, the International Civil Aviation Organization (ICAO) has developed the Global *ATM Operational Concept*, Doc. 9854 AN/458, approved by the 11th Air Navigation Conference.

2.4 Em um esforço para ajudar aos Estados com a implantação do Conceito Operacional ATM Global, a OACI publicou o novo Plano Global de Navegação Aérea. Este plano concentra-se na perspectiva de oferecer melhorias técnicas e operacionais que permitirão aos exploradores de aeronaves obter benefícios em curto e médio prazo.

2.5 O planejamento global se concentra em objetivos de performance específicos, apoiados por um conjunto de "Iniciativas do Plano Global" (GPI). O GNSS é uma ferramenta essencial para a implementação de uma série de GPI, tais como: Navegação Baseada em Performance (PBN) e Aplicações de enlaces de dados.

2.6 Desta forma, o emprego do GNSS previsto nesta AIC proporcionará a transição necessária para a aplicação das GPI envolvidas, por meio da antecipação de alguns elementos da Navegação Baseada em Performance (PBN).

3 CONCEITUAÇÃO

3.1 CONTINUIDADE

Capacidade do sistema em proporcionar informações válidas de navegação para a operação pretendida, sem a ocorrência de interrupções não programadas.

3.2 DISPONIBILIDADE

A disponibilidade de um sistema de navegação é o percentual de tempo em que são utilizáveis as informações providas por este sistema. É uma indicação da capacidade do sistema em proporcionar informações utilizáveis dentro de uma determinada zona de cobertura, bem como do percentual de tempo em que se transmitem sinais de navegação, a partir de fontes externas. A disponibilidade é função das características físicas do entorno e da capacidade técnica das instalações dos transmissores.

3.3 EQUIPAMENTOS BÁSICOS DE NAVEGAÇÃO AÉREA

Equipamentos previstos e nas quantidades estabelecidas no Regulamento Brasileiro de Homologação Aeronáutica (RBHA).

3.4 EQUIPAMENTOS SUPLEMENTARES DE NAVEGAÇÃO AÉREA

Equipamentos que devem ser utilizados em conjunto com um equipamento básico de navegação aérea. A aprovação dos equipamentos suplementares para determinada fase de voo exige que se transporte a bordo um equipamento básico de navegação aérea para a referida fase. Quanto à performance, um equipamento suplementar de navegação aérea deve satisfazer aos requisitos de precisão e de integridade para tal operação ou fase de voo, não sendo necessário satisfazer aos requisitos de disponibilidade e de continuidade.

2.4 In an effort to facilitate implementation of the Global ATM Operational Concept, ICAO has published a new Global Air Navigation Plan. The revised Plan was developed to ensure that near and medium term benefits would be realized through a focused effort.

2.5 In accordance with the Global Plan, planning will be focused on specific performance objectives, supported by a set of "Global Plan Initiatives" (GPI). The GNSS serves as an essential tool for the implementation of a series of GPI, such as: Performance-Based Navigation (PBN) and Data Link Applications.

2.6 Therefore, the use of GNSS prescribed by this AIC will bring the needed transition for the implementation of the involved GPI, by introducing some elements of the Performance-Based Navigation (PBN).

3 CONCEPTIONS

3.1 CONTINUITY

The capability of the system to perform its function without unscheduled interruptions, during the intended operation.

3.2 AVAILABILITY

The availability of a navigation system is the percentage of time that the information provided by the system is usable. It is an indication of the capacity of the system to provide usable information within the specified coverage zone, as well as the percentage of time that navigation signals transmitted, from external sources, are available to use. The availability is a function of both physical characteristics of the environment and the technical capabilities of the transmitters' installation.

3.3 BASIC EQUIPMENT OF AIR NAVIGATION

Equipment whose type and amounts are established in the Brazilian Rules of Aeronautical Homologation.

3.4 SUPPLEMENTAL EQUIPMENTS OF AIR NAVIGATION

Equipments that shall be used together with a basic equipment of air navigation. The approval of the supplemental equipment for a certain flight phase demands that a basic equipment of air navigation is transported on board for the referred flight phase. Concerning the performance, a supplemental equipment of air navigation shall satisfy the accuracy and integrity requirements for such operation or flight phase, not being necessary to satisfy the availability and continuity requirements.

3.5 INTEGRIDADE

Garantia de que todas as funções do sistema de navegação estão dentro dos limites de performance operacional. É a capacidade do sistema de navegação aérea de proporcionar aos usuários avisos oportunos nos casos em que o mesmo não deva ser utilizado.

3.6 MONITORAMENTO AUTÔNOMO DE INTEGRIDADE ASSOCIADO AO RECEPTOR (RAIM)

Técnica através da qual um receptor GNSS determina a integridade dos sinais de navegação sem se referenciar a sensores ou a sistemas de integridade externos ao próprio receptor.

3.7 NAVEGAÇÃO DE ÁREA (RNAV)

É um método de navegação que permite a operação de aeronave em qualquer trajetória desejada dentro da cobertura de auxílios à navegação aérea ou dentro dos limites de capacidade de sistemas autônomos ou a combinação destes.

3.8 NAVEGAÇÃO EM ÁREA TERMINAL

Fase da navegação em que as aeronaves seguem rotas especificadas de saída ou chegada (SID ou STAR) ou qualquer outra operação entre o último fixo em rota e o fixo de aproximação inicial (IAF).

3.9 NAVEGAÇÃO VERTICAL BAROALTIMÉTRICA (Baro-VNAV).

É um sistema de navegação que apresenta ao piloto um guia vertical calculado com referência a um ângulo de trajetória vertical especificada (VPA), nominalmente de 3º. O guia vertical calculado pelo computador é baseado na altitude baroaltimétrica e especifica um ângulo de trajetória vertical desde a altura do ponto de referência (RDH) para procedimentos de aproximação com guia vertical (APV).

3.10PRECISÃO

É o grau de conformidade entre a informação sobre posição e hora que proporciona o sistema de navegação e a posição e hora verdadeiras.

3.11 PROCEDIMENTO DE APROXIMAÇÃO COM GUIA VERTICAL (APV)

Procedimento de Aproximação por instrumentos que utiliza guia lateral e vertical, porém não satisfazendo os requisitos estabelecidos para as operações de aproximação de precisão.

3.5 INTEGRITY

The assurance that all the functions of the navigation system are within operational performance limits. It is the capacity of the air navigation system to provide the users with opportune warnings in case it shall not be used.

3.6 RECEIVER AUTONOMOUS INTEGRITY MONITORING (RAIM)

Technique whereby an airborne GNSS receiver determines the integrity of the navigation signals without referring to other sensors or to other integrity systems external to the receiver.

3.7 AREA NAVIGATION (RNAV)

A method of navigation which permits aircraft operation on any desired flight path within the coverage of station-referenced navigation aids or within the limits of the capability of self-contained aids, or a combination of these.

3.8 NAVIGATION IN THE TERMINAL AREA

Phase of navigation when the aircraft follow specific routes for departure or arrival (SID or STAR), or any other operation between the last fix en route and the initial approach fix (IAF).

3.9 BAROMETRIC VERTICAL NAVIGATION (Baro-VNAV)

It is a navigation system which presents computed vertical guidance to the pilot referenced to a specific Vertical Path Angle (VPA), nominally three degrees. The onboard avionics computer resolves vertical guidance data based on barometric altitude and it is specified as vertical guidance angle from the Reference Datum Height (RDH) to the approach procedures with vertical guidance (APV).

3.10 ACCURACY

The degree of conformance between the position and time information provided by the navigation system and the true position and time.

3.11 APPROACH PROCEDURE WITH VERTICAL GUIDANCE (APV)

An approach with vertical guidance is an instrument approach procedure which utilizes lateral and vertical guidance, but which does not meet all the performance requirements needed for precision approach and landing operations.

3.12 ROTA RNAV

É uma rota ATS estabelecida para aeronaves capazes de empregar navegação de área.

4 SISTEMA GLOBAL DE NAVEGAÇÃO POR SATÉLITES (GNSS)

4.1 A constelação satelital atualmente disponível para uso operacional é o "Global Positioning System (GPS)" provido pelos Estados Unidos da América, entretanto, outros sistemas estão em desenvolvimento e atenderão aos Padrões e Normas Recomendados (SARPS), da OACI. Os sinais do GPS necessitam ser melhorados de forma a atender os requisitos operacionais para as diversas fases do voo.

4.2 A navegação GNSS é baseada em um contínuo conhecimento da posição espacial de cada satélite e proporciona precisão horizontal da ordem de 20 metros, com 95% de probabilidade (95 % do tempo) e 300 metros com 99,99% de probabilidade, sem a utilização de técnicas destinadas a melhorar a performance do sistema.

4.3 No entanto, a constelação básica GPS não provê avisos com antecedência suficiente, quando um satélite transmite uma informação inválida. Por esta razão, os aviônicos utilizados para navegação IFR devem melhorar o sinal Básico GPS para, além de outros fatores, assegurar sua integridade.

4.4 O termo "Aircraft Based Augmentation System (ABAS)" inclui uma melhoria e/ou integração do GNSS com as informações disponíveis a bordo da aeronave, de forma a melhorar a performance dos sistemas satelitais.

4.5 A técnica ABAS mais comum é chamada "Receiver Autonomous Integrity Monitoring System (RAIM)". O RAIM usa medidas satelitais redundantes para detectar sinais errôneos e alertar aos pilotos.

4.6 Um receptor GNSS que se apóie unicamente na função RAIM necessita de um mínimo de 5 (cinco) satélites em linha de visada, tornando necessário que o piloto efetue verificações de disponibilidade da função RAIM, antes de ingressar nas fases de navegação pretendidas (rota, chegada, saída, e/ou aproximação).

3.12 RNAV ROUTE

It is an ATS route established for aircraft capable of using area navigation.

4. GLOBAL NAVIGATION SATELLITE SYSTEM (GNSS)

4.1 The satellite navigation systems available for operational use is the Global Positioning System (GPS) of the United States. However other systems are being introduced and they will answer the ICAO Standard and Recommended Procedures. The GPS signals must be improved in order to support the operational requirements for the various phases of flight.

4.2 The GNSS navigation is based on a continuous acknowledge of the spatial position of each satellite and provides horizontal accuracy of around 20 meters, with 95% of probability (95% of time) and 300 meters with 99,99% probability, without using the techniques destined to improve the performance of the system.

4.3 However the basic constellation of GPS does not provides warnings with priority enough, when the satellite provides invalid information. For this reason, the avionics used for the IFR navigation must improve the GPS Basic signal to also guarantee their integrity.

4.4 The term Aircraft Based Augmentation System (ABAS) includes a development and/or an integration of the GNSS with the information available onboard, in order to improve the performance of the satellite systems.

4.5 The most common ABAS technique is known as Receiver Autonomous Integrity Monitoring System (RAIM). The RAIM uses redundant additional satellite measures to check any incorrect signals and to warn the pilots.

4.6 A GNSS receiver that performs only the RAIM function requires at least 5 (five) satellites in sight, as the pilot should check the appropriate RAIM function availability before entering the desired phases of navigation (route, arrival, departure and/or approach).

5 CRITÉRIOS DE UTILIZAÇÃO DO GNSS

5.1 CRITÉRIOS GERAIS

5.1.1 Os procedimentos de navegação aérea previstos nesta AIC (Rota, Chegada, Saída e Aproximação) somente deverão ser executados por operadores e aeronaves aprovados pelo Estado de Registro ou Estado do Operador, conforme o caso. O processo de aprovação de operadores e aeronaves brasileiras é estabelecido pela Agência Nacional de Aviação Civil.

5.1.2 Tipicamente os receptores GNSS devem atender, pelo menos, aos requisitos estabelecidos no Anexo 10, volume I, e no Doc. 9613 (Manual PBN), ambos da Organização de Aviação Civil Internacional, observando as classes de equipamentos necessárias para a operação em cada fase do voo. No entanto, o processo de aprovação de aeronaves e operadores, mencionado em 5.1.1, determinará as exigências quanto aos receptores GNSS.

5.1.3 O receptor GNSS Básico verifica a integridade dos sinais recebidos da constelação de satélites, através de um monitor autônomo de integridade (RAIM), de forma a determinar se os satélites estão fornecendo uma informação confiável. Alarmes de RAIM podem ocorrer devido a um número insuficiente de satélites ou devido a uma geometria inadequada dos satélites, que podem fazer com que o nível de confiança na solução de posição seja inferior ao aceitável. A posição da antena na aeronave, a posição dos satélites em relação ao horizonte e a atitude da aeronave podem afetar a recepção do sinal de um ou mais satélites. Considerando o fato de que a posição relativa dos satélites está em constante mudança, a disponibilidade de RAIM deverá sempre ser avaliada. Se o RAIM não estiver disponível, outro tipo de navegação deve ser usado ou o horário do voo modificado até que o RAIM esteja disponível. Em voos longos, os pilotos devem considerar a avaliação periódica do RAIM durante o voo. Isto pode prover indicações antecipadas de uma falha não programada de um satélite a partir da decolagem.

5.1.4 As coordenadas geográficas utilizadas nos procedimentos de navegação aérea baseados em GNSS e nas cartas publicadas pelo DECEA têm como referência o Sistema Geodésico Mundial (WGS-84).

5.1.5 Deverá ser feita a previsão de disponibilidade da função RAIM antes da decolagem e do ingresso em cada uma das fases do voo.

5 CRITERIA FOR THE USE OF GNSS

5.1 GENERAL CRITERIA

5.1.1 The procedures for the air navigation included in this AIC (Route, Arrival, Departure and Approach) must be accomplished only by the operators and the aircraft approved by the State of the Register or the State of the Operator, according to the situation. The process for the approval of the Brazilian operators and aircraft are established by the Civil Aviation National Agency (ANAC).

5.1.2 Usually, the GNSS receivers must attend, at least, the requirements established in the Annex 10, volume I, and in the Doc. 9613 (PBN Manual) , observing the classes of equipments needed for the operation in each phase of flight. However, the process for aircraft and operator approval, mentioned above in 5.1.1, will determine the requirements for the GNSS receivers.

5.1.3 The Basic GNSS receiver verifies the integrity of the signals received by the constellation of satellites through a Receiver Autonomous Integrity Monitoring System (RAIM), in order to determine if the satellites are furnishing trustful information. RAIM alarms may occur due to a small number of satellites or due to inadequate geometry of the satellites that may turn the trust level in the position solution lower than the acceptable. The position of the aircraft antenna, the position of the satellites in relation to the horizons and the attitude of the aircraft may affect the reception of the signal of one or more satellites. Considering the fact that the relative position of the satellites is always changing, the availability of the RAIM must always be evaluated. When the RAIM is not available, other type of navigation must be used or the schedule of the flight must be changed until the RAIM is available again. During long flights, the pilots must consider the periodic evaluation of the RAIM during the flight. This may furnish indications of a non predictable failure from a satellite since the departure.

5.1.4 The geographical coordinates used in the air navigation procedures based on GNSS and on the charts published by DECEA have as reference the World Geodetic System (WGS-84).

5.1.5 A prediction of the availability of the RAIM function must be made before the departure and the entrance to each phase of flight.

5.1.6 As informações de altitude utilizadas deverão ser fornecidas pelo altímetro barométrico da aeronave.

5.1.7 Quando houver discrepância significativa entre as informações do receptor GNSS e dos auxílios à navegação aérea instalados no solo, os pilotos deverão utilizar as informações provenientes destes últimos.

5.1.8 Os operadores de aeronaves não devem solicitar ou inserir no plano de voo procedimentos de navegação aérea baseados em GNSS, caso não tenham recebido a correspondente aprovação operacional e da aeronave pela autoridade competente, conforme previsto em 5.1.1. Neste caso, se uma aeronave receber uma autorização do órgão ATS para executar um procedimento GNSS, o piloto deverá informar a incapacidade de atender a autorização e requerer uma nova autorização.

5.1.9 É recomendável a aplicação de diretor de voo ou piloto automático, no modo de navegação lateral, quando disponível, nas operações em rota, terminal (SID e STAR) e Procedimentos de Aproximação IFR.

5.1.10 Os órgãos ATS não estão aptos a fornecer qualquer informação sobre a integridade operacional do sistema. Isto é particularmente importante quando a aeronave for autorizada a iniciar uma aproximação. Procedimentos devem ser estabelecidos para os casos em que forem previstas falhas na navegação GNSS. Nestas situações os pilotos devem reverter para um método alternativo de navegação.

5.1.11 BASE DE DADOS DE NAVEGAÇÃO

5.1.11.1 Os operadores deverão assegurar-se que a base de dados utilizada para navegação esteja atualizada de acordo com o ciclo AIRAC correspondente. A base de dados de navegação deve estar atualizada para a duração do voo. Em caso de ocorrência de mudança do ciclo AIRAC durante o voo, operadores e pilotos devem estabelecer procedimentos para assegurar a precisão dos dados de navegação, incluindo os auxílios requeridos para definir rotas e procedimentos.

5.1.11.2 Para assegurar a correção da base de dados, os pilotos devem verificar os dados apresentados no “display” do equipamento, após o carregamento do mesmo no plano de voo ativo, antes de voar o procedimento, a fim de garantir a correção e a coerência da rota autorizada pelo ATC e as eventuais modificações subsequentes, assim como sua coerência com as cartas publicadas pelo DECEA. Caso não haja conformidade, as informações da base de dados não poderão ser utilizadas. Alguns receptores possuem um “moving map display” que ajuda o piloto na condução das citadas verificações.

5.1.6 The information on the altitude used must be supplied by the barometric altimeter of the aircraft.

5.1.7 When there is a significant discrepancy between the information from the GNSS receiver and the air navigation aids installed on the ground, the pilots must use the information provided by such aids.

5.1.8 The aircraft operators should not request or include in the flight plan the air navigation procedures based on GNSS, when they do not receive the corresponding operational and aircraft approval by the competent authority, according to the prescribed in the item 5.1.1. In such case, if an aircraft receives a clearance from the ATS unit to accomplish a GNSS procedure, the pilot must inform that he/she can not accomplish the authorization and request another one.

5.1.9 It's recommendable, when available, the use of a flight director or autopilot in lateral navigation mode in en route, terminal (SID and STAR) Operations and IFR Approach Procedures.

5.1.10 The ATS units are not capable to furnish any information on the operational integrity of the system. This is especially important when the aircraft is authorized to begin an approach. Procedures must be established for the instances when failures on the GNSS are foreseen. In such situations the pilots must reverse to an alternative navigation method.

5.1.11 NAVIGATION DATABASE

5.1.11.1 The operators must assure that the database used for the navigation is updated with the corresponding AIRAC cycle. The navigation database must be updated for the flight duration. If there is any change to the AIRAC cycle during the flight, the operators and pilots must establish procedures to assure the accuracy of the navigation data, including the air navigation aids required to define the routes and procedures.

5.1.11.2 To assure the correctness of the data base, the pilots must check the data showed on the display of the equipment, after stored on the active flight plan, before flying the procedure, in order to guarantee the correctness and the coherency of the route authorized by the ATC and any occasional subsequent changes, as well as its coherency with the charts published by DECEA. If there is any discrepancy, information on the data base shall not be used. Some receivers have a moving map display that helps the pilot to check such information.

5.1.11.3 A Base de Dados de Navegação deve ser obtida de um provedor que atenda aos requisitos estabelecidos nos documentos RTCA DO-200A/EUROCAE ED 76, “Standards for Processing Aeronautical Data”, conforme previsto no Doc. 9613 (Manual PBN).

5.1.11.4 Discrepâncias que invalidem um procedimento devem ser reportados ao provedor de base de dados de navegação e os procedimentos não devem ser utilizados pelos tripulantes de voo.

5.1.11.5 Os operadores de aeronaves devem conduzir verificações periódicas na base de dados de navegação, a fim de atender aos requisitos de garantia de qualidade do sistema.

5.1.12 PRÉ-VOO

5.1.12.1 Todas as operações IFR com um receptor GNSS devem ser conduzidas de acordo com o manual de operações da aeronave. Antes de um voo IFR empregando o receptor GNSS, o operador deverá assegurar-se de que a operação, o equipamento e a instalação estejam aprovados e certificados pela autoridade competente para a operação IFR pretendida.

5.1.12.2 O piloto/operador deverá seguir os procedimentos específicos de inicialização e autoteste para o receptor GNSS como descrito no manual de operações da aeronave.

5.1.12.3 O piloto deverá conhecer, dentre outros aspectos constantes do processo de aprovação operacional, mencionado em 5.1.1:

a) Operação e limitações do receptor GNSS instalado em sua aeronave, incluindo criação, ativação/alteração de rotas, seleção e ativação de procedimentos de subida e de descida;

b) Procedimentos para verificação da disponibilidade da função RAIM; e

c) Seleção dos modos de navegação em Rota, em Terminal e em Aproximação.

5.2 CRITÉRIOS ESPECÍFICOS

5.2.1 VOO EM ROTA

5.2.1.1 As aeronaves voando sob regras de voo por instrumentos deverão possuir os equipamentos básicos de navegação aérea (ver item 3.3) apropriados para a rota a ser voada, os quais deverão obrigatoriamente ser utilizados, caso haja alarme de integridade e nos trechos da rota em que haja previsão de indisponibilidade da função RAIM.

5.1.11.3 The Navigation Data Base must be obtained through a provider that complies with the requirements established by the documents RTCA DO-200A/EUROCAE ED 76 “Standards for Processing Aeronautical Data”, as foreseen in Doc. 9613 (PBN Manual).

5.1.11.4 Discrepancies that invalidate a procedure must be reported to the navigation database supplier and affected procedures shall not be used by flight crew.

5.1.11.5 Aircraft operators should consider the need to conduct their own database checks in order to comply with the requirements for the quality assurance of the system.

5.1.12 PREFLIGHT

5.1.12.1 All the IFR operations with a GNSS receiver must be conducted according to the aircraft operations manual. Before flying IFR, using a GNSS receiver, the operator must be sure that the operation, the equipment and the installation are approved and certified by the competent authority for the intended IFR operation.

5.1.12.2 The pilot/operator must follow the specific procedures at the beginning of initialization and auto-test of the GNSS receiver as described on the aircraft operations manual.

5.1.12.3 The pilot must know, among others aspects included in the operational approval process, mentioned on 5.1.1:

a) Operation and limitation of the GNSS receiver installed in the aircraft, including the route creation and route activation/deactivation, as well as selection and activation of departure and approach procedures.

b) Procedures to check the availability of RAIM function;

c) Selection of navigation modes: en Route, Terminal and Approach.

5.2 SPECIFIC CRITERIA

5.2.1 EN ROUTE FLIGHT

5.2.1.1 Aircraft flying under instrument flight rules shall have the basic equipment for air navigation (see item 3.3) appropriate for the route to be flown. Such equipment shall be used compulsorily, when there is an integrity alarm and on the portion of the route where the function RAIM is supposed to be unavailable.

5.2.2 CHEGADA PADRÃO POR INSTRUMENTOS (STAR) E SAÍDA PADRÃO POR INSTRUMENTOS (SID)

5.2.2.1 Os equipamentos das aeronaves deverão ser aprovados de acordo com a classe de equipamento prevista para execução de SID ou STAR GNSS.

5.2.2.2 As aeronaves executando SID GNSS ou STAR GNSS deverão estar com seus equipamentos básicos de navegação sintonizados nas frequências adequadas, de forma a proporcionar transição rápida e segura no caso de ocorrência de alarme de RAIM. Caso haja previsão de indisponibilidade da função RAIM durante o período de voo, somente deverão ser utilizados os equipamentos básicos de navegação aérea.

5.2.2.3 A STAR e a SID GNSS só poderão ser utilizadas caso sejam extraídas de uma base de dados, por meio da inserção do designador do procedimento, que:

a) Contenha todos os “way-points” descritos na carta que descreve o procedimento de aproximação a ser voado; e

b) Apresente os “way-points” na mesma sequência em que estão publicadas na carta que descreve o procedimento.

5.2.2.4 A sequência de “way-points” estabelecida nas STAR e SID pode ser modificada pelo piloto, como resultado de autorizações ATC, por meio da inserção (a partir da base de dados) e da exclusão de “way-points”.

5.2.2.5 Na execução de SID e STAR RNAV não é permitida:

a) A criação manual de novos “way-points”, não previstos na base de dados, por meio da inserção de coordenadas geográficas ou quaisquer outros meios.

b) A modificação do tipo de “way-point”, de “fly-over” para “fly-by” e vice-versa.

5.2.2.6 Caso a aeronave seja retirada de sua rota pré-estabelecida, em consequência de uma vetoração radar, o piloto não deve modificar o plano de voo inserido no sistema, até que uma nova autorização seja emitida pelo controlador de tráfego aéreo, a fim de que seja possível voltar à rota inicial, em um ponto especificado pelo órgão ATC ou empregar uma nova rota autorizada.

5.2.2 STANDARD TERMINAL ARRIVAL ROUTES (STAR) AND STANDARD INSTRUMENT DEPARTURE (SID)

5.2.2.1 The equipments of the aircraft must be approved according to the class of the equipment prescribed for the execution of the SID or STAR GNSS.

5.2.2.2 Aircraft accomplishing GNSS SID or GNSS STAR must have their basic navigation equipment tuned on the appropriate frequencies, so as to provide fast and safe transition in the case of occurrence of RAIM alarm. In case that there is prevision of unavailability of the RAIM function during the flight period, only the basic equipment of air navigation shall be used.

5.2.2.3 GNSS STAR and GNSS SID may be used only when extracted from a data base, by inserting the procedure designator, that;

a) Include all waypoints described by the chart that describes the approach procedure to be flown; and

b) Show the waypoints on the same sequence as they are published by the chart that describes the procedure.

5.2.2.4 The sequence of waypoints established by the STAR and SID may be changed by the pilot, as a result of the ATC clearances, by the inclusion (from the database) and exclusion of the waypoints.

5.2.2.5 The following is not allowed when accomplishing the SID and STAR RNAV:

a) The manual creation of new waypoints, not prescribed by the database, by including the geographical coordinates or by any other means.

b) The change on the type of the waypoint from fly-over to fly-by and vice versa.

5.2.2.6 When the aircraft is removed from the determined route, as a consequence from the radar vectors, the pilot must not change the flight plan included on the system, until a new clearance is issued by the air traffic controller, in order to come back to the initial route, at a point specified by the ATC unit or apply a new cleared route.

5.2.2.7 Os pilotos poderão observar pequenas diferenças entre o rumo publicado nas cartas de navegação e o rumo apresentado no receptor GNSS. Tais situações são normalmente resultantes de diferenças entre a declinação magnética aplicada pelo equipamento e a aplicada por ocasião da confecção das cartas. Diferenças menores ou iguais a 3º são operacionalmente aceitáveis, conforme previsto no item 3.3.4.2 do Doc. 9613 (Manual PBN).

5.2.2.8 Os pilotos deverão empregar um indicador de desvio lateral, diretor de voo ou piloto automático no modo de navegação lateral.

5.2.2.9 No caso de execução de SID, o piloto deverá seguir o previsto no manual de operações, a fim de garantir que o modo "saída" (departure) do receptor seja selecionado. Se o modo "saída" não estiver disponível, então o modo terminal deve ser selecionado para assegurar a performance requerida.

5.2.2.10 Alguns segmentos de uma SID podem requerer uma intervenção manual do piloto, especialmente quando uma vetoração radar é utilizada para interceptação de um rumo ou bloqueio de um fixo.

5.2.3 PROCEDIMENTOS DE APROXIMAÇÃO GNSS

5.2.3.1 Planejamento Pré-Voo

5.2.3.1.1 Além das verificações normais realizadas no planejamento pré-voo, os seguintes procedimentos devem ser executados:

a) O piloto deve assegurar-se que os procedimentos de aproximação, incluindo aqueles dos aeródromos de alternativa, são selecionáveis de uma base de dados de navegação válida e atualizada e cuja execução não está proibida por instrução da companhia aérea ou NOTAM.

b) O piloto deve assegurar-se que os auxílios à navegação aérea necessários para as operações no aeródromo de alternativa estão disponíveis.

c) O piloto deve tomar conhecimento de NOTAM ou material disponibilizado em briefings que possam afetar adversamente a operação do sistema da aeronave ou a disponibilidade dos procedimentos de aproximação no aeródromo de destino e/ou de alternativa.

d) O piloto deverá designar um aeroporto de alternativa que possua procedimento de aproximação em operação baseado em auxílios à navegação aérea convencionais.

5.2.2.7 Pilots may observe small differences between the heading included in the navigation charts and the heading shown by the GNSS receiver. Usually such situations are caused by the difference between the magnetic declination applied to the equipment and the one applied during the issue of the charts. Differences equal to or lesser than 3 degree are operationally accepted, as foreseen in Doc. 9613 (PBN Manual), item 3.3.4.2.

5.2.2.8 Pilots must use a lateral deviation indicator, flight director or autopilot on the lateral navigation mode.

5.2.2.9 When accomplishing the SID, the pilot must follow the prescribed on the operations manual, in order to guarantee that the departure mode of the receiver is selected. When the departure mode is not available, the terminal mode must be selected to ensure the required performance.

5.2.2.10 Some portions of one SID may require a manual intervention of the pilot, especially when radar vectors are used to intercept a heading to or over heading a waypoint.

5.2.3 GNSS APPROACH PROCEDURES

5.2.3.1 Pre-Flight Planning

5.2.3.1.1. In addition to normal procedure prior to commencing the approach the crew must verify the following procedures:

a) Pilot must assure that the approach procedures, including the alternative aerodromes, are collected from a valid and updated navigation data base and that the execution is not forbidden by any air company instruction or by NOTAM.

b) Pilot must assure that the air navigation aids needed to the aerodrome operations at the alternative aerodrome are available;

c) The pilot must be aware of the NOTAM or any available information included in briefing that may affect adversely the operation of the aircraft system or the availability of the approach procedures at the destined aerodrome and/or the alternative aerodrome.

d) Pilot must designate an alternative aerodrome that offers an approach procedure in operation based in conventional air navigation aids

5.2.3.2 Procedimentos Operacionais da Tripulação antes do Início da Execução do Procedimento de Aproximação

5.2.3.2.1 Além dos procedimentos normais previstos, antes do início da execução de um procedimento de aproximação IFR, o piloto deve, antes de atingir o Fixo de Aproximação Inicial (IAF) e de forma compatível com a carga de trabalho da tripulação, verificar a correção do procedimento carregado no sistema da aeronave, comparando-o com a carta publicada, incluindo a sequência dos “waypoints” e a coerência de rumos e distâncias;

5.2.3.2.2O piloto deve checar, a partir das cartas publicadas, “map display” ou “Control Display Unit” (CDU), os tipos de “way-points” que serão utilizados (“fly-by” ou “fly-over”).

5.2.3.2.3 Para sistemas multi-sensores, o piloto deve se certificar que o sensor GNSS está sendo utilizado para o estabelecimento de posição da aeronave.

5.2.3.2.4 As aeronaves devem iniciar um procedimento de aproximação GNSS a partir do Fixo de Aproximação Inicial (IAF). No entanto, intervenções táticas do ATC podem ser necessárias por intermédio de uma vetoração radar ou autorização para voo direto para fixos específicos, que poderão resultar em interceptação da fase inicial ou intermediária do procedimento de aproximação, sem passar pelo Fixo de Aproximação Inicial (IAF) e/ou Fixo Intermediário (IF). Além disso, poderá ser necessária a inserção de “way-point” carregado a partir da base de dados. Ao cumprir as instruções do ATC, a tripulação deve atentar para o seguinte:

a) A entrada manual de coordenadas no sistema de navegação, para operações em área de controle terminal, incluindo procedimentos de aproximação IFR, não é permitida;

b) Todas as altitudes mínimas previstas no procedimento devem ser observadas;

c) O ingresso diretamente no Fixo Intermediário pode não assegurar a correta separação de obstáculos, caso não seja observada as instruções do ATC. Além disso, o ângulo de interceptação do curso, nesse fixo, deve ser menor ou igual a 45º, conforme previsto no item 5.3.4.2 do Doc. 9613 (Manual PBN); e

d) Autorizações de proa direta para o Fixo de Aproximação Final (FAF) não são permitidas.

5.2.3.2 Operational Procedures of the Crew before the Beginning of the Approach Procedure

5.2.3.2.1 Besides the normal procedures in force, before the beginning of the IFR approach procedure, the pilot must, before reaching the Initial Approach Fix (IAF) and according to an adequate workload, check if the procedure stored on the aircraft system is correct, comparing it with the published chart, including the sequence of waypoints and the coherency of the headings and distances;

5.2.3.2.2 Pilot must also check from the published charts, map display or Control Display Unit (CDU), which waypoints are fly-by and which are fly-over.

5.2.3.2.3 For multi-sensor systems, crew must verify that GNSS sensor is used for position computation.

5.2.3.2.4 Aircraft must begin the GNSS approach procedure from an Initial Approach Fix (IAF). However, tactical interventions from the ATC may be needed by means of a radar vectors or clearance to a direct flight to specific fixes that may result in interception of the initial or intermediate phase of the approach procedure, without passing the Initial Approach Fix (IAF) and/or Intermediate Fix (IF). Moreover, the inclusion of the waypoint stored from the database may be needed. In complying with ATC instructions, the flight crew should be aware of the following implications:

a) The manual entry of coordinates into the navigation system by the crew for operations in terminal control area is not permitted.

b) All the minima altitudes prescribed by the procedure must be observed;

c) The entrance directly to the Intermediate Fix may not assure the correct separation of the obstacles, when the ATC instructions are not observed. Moreover, the angle of course interception, on such fix, must be smaller or equal to 45 Degrees; and

d) Direct to clearance to FAF (Final Approach Fix) is not acceptable.

5.2.3.3 Procedimentos Operacionais após o Início da Execução do Procedimento de Aproximação IFR

5.2.3.3.1 A aeronave deve estar estabilizada no curso da aproximação final antes do FAF, a fim de iniciar a descida no segmento de aproximação final.

5.2.3.3.2 A tripulação deve verificar se o modo aproximação do sistema foi ativado, 2 NM antes de passar o FAF.

5.2.3.3.3 O display apropriado deve ser selecionado, a fim de que a trajetória desejada e a posição relativa da aeronave em relação à trajetória possam ser monitoradas, a fim de permitir a avaliação constante do erro técnico de voo (FTE).

5.2.3.3.4 O procedimento deve ser descontinuado:

a) Se o display de navegação considerar o sistema inválido (“flagged”); ou

b) No caso de perda da função de monitoração de integridade; ou

c) Se a função de monitoração de integridade não estiver disponível antes de passar o FAF; ou

d) Se o Erro Técnico de Voo (FTE) for excessivo, conforme previsto no processo de aprovação operacional, mencionado no item 5.1.1.

NOTA: No caso de emprego de equipamentos que demonstrem capacidade RNP sem a utilização do GNSS, a interrupção do procedimento poderá não ser necessária. A documentação do fabricante deverá ser analisada para determinar como o sistema de navegação da aeronave poderá ser empregado nestas condições. Tais procedimentos deverão ser inseridos no processo de aprovação operacional.

5.2.3.3.5 Durante a execução do procedimento de aproximação, os pilotos devem utilizar um indicador de desvio lateral, diretor de voo e/ou piloto automático, no modo de navegação lateral. Pilotos que empreguem o indicador de desvio lateral (Ex. CDI) devem assegurar que a escala adequada esteja selecionada, de acordo com a precisão de navegação associada aos vários segmentos do procedimento (ex. ±1.0 NM para os segmentos inicial e intermediário, ±0.3 NM para o segmento final).

5.2.3.3 Operational Procedures after the Beginning of the Accomplishment of the IFR Approach

5.2.3.3.1 The aircraft must be established on the final approach course no later than the FAF before starting the descent at the final approach segment.

5.2.3.3.2 The crew must check if the approach mode system is activated, within 2 NM before the FAF.

5.2.3.3.3 The appropriate display must be selected so that the desired path and the aircraft position relative to the path can be monitored for FTE (Flight Technical Error) monitoring.

5.2.3.3.4 The procedure must be discontinued:

a) If the navigation display is flagged invalid; or

b) In case of loss of integrity alerting function; or

c) If integrity monitoring function is not available before passing the FAF; or

d) If Flight Technical Error (FTE) is excessive, as prescribed by the operational approval process, mentioned in 5.1.1**.**

NOTE: Discontinuing the procedure may not be necessary for a RNP system that includes demonstrated RNP capability without GNSS. Manufacturer documentation should be examined to determine the extent the system may be used in such configuration. Such procedure must be included in the operational approval process.

5.2.3.3.5 During the approach procedure, pilots must use a lateral deviation indicator, flight director and/or autopilot in lateral navigation mode. Pilots of aircraft with a lateral deviation indicator (e.g., CDI) must ensure that lateral deviation indicator scaling is suitable for the navigation accuracy associated with the various segments of the procedure (i.e., ±1.0 nm for the Initial and Intermediate segments, ±0.3 nm for the Final Approach segment).

5.2.3.3.6 Os pilotos devem voar no eixo da trajetória do procedimento de aproximação, conforme apresentado nos indicadores de desvios laterais e/ou diretor de voo, a menos que sejam autorizados desvios pelo ATC ou em caso de emergência. Em condições normais de operação, os desvios laterais (diferença entre a trajetória prevista nos sistema de bordo e a posição da aeronave em relação à trajetória) deve ser limitada à metade da precisão de navegação associada com o segmento de procedimento. No caso dos segmentos inicial e intermediário, cuja precisão associada normalmente é de 1 NM, o desvio máximo tolerável é de 0,5 NM. No segmento final, a precisão é normalmente de 0,3 NM e o desvio máximo é de 0,15 NM. Pequenos desvios destes limites durante e imediatamente após as curvas, até um máximo do valor correspondente ao valor de precisão associado ao segmento (ex. 1 NM para os segmentos inicial e intermediário) são aceitáveis.

5.2.3.3.7 No caso de emprego de Baro-VNAV para guia vertical, durante o segmento de aproximação final, desvios acima e abaixo da trajetória definida pelo sistema Baro-VNAV não pode exceder, respectivamente, 100 e 50 pés.

5.2.3.3.8 Os pilotos devem executar uma aproximação perdida, caso os desvios laterais e/ou verticais excedam os valores previstos nos itens 5.2.3.3.6 ou 5.2.3.3.7, a menos que sejam obtidas as referencias visuais para continuar a aproximação.

5.2.3.4 Procedimentos de Contingência

5.2.3.4.1 O piloto deve notificar o órgão ATS, o mais breve possível, sobre a perda de capacidade de efetuar o procedimento de aproximação GNSS, incluindo as intenções da tripulação a respeito dos procedimentos a serem seguidos. A perda de tal capacidade inclui qualquer falha ou evento que leve a aeronave à não satisfazer os requisitos estabelecidos para o procedimento. O operador da aeronave deve desenvolver procedimento de contingência adequado para garantir a segurança da aeronave em caso de perda da capacidade GNSS durante uma aproximação.

5.2.3.5 Procedimentos de Aproximação com Guia Vertical, baseados em Navegação Vertical Baroaltimétrica (APV/Baro-VNAV)

5.2.3.5.1 Alguns procedimentos de aproximação baseados em GNSS poderão especificar mínimos com navegação vertical (VNAV). Esses procedimentos se baseiam no GNSS para navegação lateral (LNAV) e em dados baroaltimétricos como guia para navegação vertical (VNAV).

5.2.3.3.6 All pilots are expected to maintain procedure centerlines, as depicted by onboard lateral deviation indicators and/or flight director during all the approach procedure unless cleared to deviate by ATC or under emergency conditions. For normal operations, cross-track error/deviation (the difference between the route navigation system computed path and the aircraft position relative to the path) should be limited to half the navigation accuracy associated with the procedure. In case of Initial and Intermediate Segments, taking into consideration that the associated precision is 1,0 NM, the maximum deviation is 0, 5 NM. On the Final Segment, the normal associated precision is 0,3 NM, so the maximum deviation is 0,15 NM. Brief deviations from this standard during and immediately after turns, up to a maximum of the navigation accuracy value (i.e., 1 NM for the Initial and Intermediate segments), are allowable.

5.2.3.3.7 When Baro-VNAV is used for vertical path guidance during the final approach segment, deviations above and below the Baro-VNAV path must not respectively exceed +100/-50 feet.

5.2.3.3.8 Pilots must execute a Missed Approach if the lateral deviations or vertical deviations exceed the values prescribed on items 5.2.3.3.6 or 5.2.3.3.7 above, unless the pilot has in sight the visual references required to continue the approach.

5.2.3.4 Contingency Procedures

5.2.3.4.1 The pilot must notify ATS, as soon as possible, of any loss of the GNSS approach procedure capability, together with the proposed course of action. The loss of such capability includes any failure or event causing the aircraft to no longer satisfy the requirements of the procedure. The aircraft operator must develop the corresponding contingency procedure to guarantee the aircraft safety during an approach procedure, in case of any loss of the GNSS Capability.

5.2.3.5 Approach Procedures with vertical guidance, based on Barometric Vertical Navigation (APV/Baro-VNAV).

5.2.3.5.1 Some approach procedures based on GNSS may specify minima with vertical navigation (VNAV). Such procedures are based on GNSS for the lateral navigation (LNAV) and on baro-altimetric data as guidance for vertical navigation (VNAV).

5.2.3.5.2 Operadores de aeronaves que desejarem executar procedimentos APV/Baro-VNAV deverão obter a aprovação de aeronave e de operações correspondente, conforme previsto no item 5.1.1. Caso não possuam tal aprovação operacional, essas aeronaves deverão cumprir somente os mínimos LNAV, ou seja, somente a navegação lateral baseada no GNSS deverá ser utilizada.

5.2.3.5.3 Os pilotos são responsáveis por qualquer correção de altitudes publicadas, em função da variação de temperatura, incluindo:

a) As altitudes dos segmentos inicial e intermediário;

b) A altitude/altura de decisão; e

c) As altitudes da aproximação perdida subsequente.

5.2.3.5.4 Os procedimentos APV/BARO-VNAV só deverão ser executados com a informação do ajuste local fornecido pelo órgão ATS (diretamente ou por meio do ATIS) do aeródromo, corretamente inseridos no sistema altimétrico da aeronave. Ajustes de altímetro procedentes de uma fonte remota não podem ser utilizados em procedimentos APV/Baro-VNAV.

5.2.3.5.5 Os limites de temperatura mínimas e máximas autorizadas para operações Baro-VNAV serão publicadas na Carta do procedimento de aproximação APV/Baro-VNAV.

5.2.3.6 Plano de Voo

5.2.3.6.1 No Plano de Voo, será inserida, no item (campo) 10, a letra “G” indicando que a aeronave dispõe de equipamento receptor GNSS, aprovado conforme previsto no item 5.1.1.

NOTA: A existência a bordo de equipamento GNSS não dispensa a exigência dos equipamentos básicos de navegação aérea, requeridos para os diversos tipos e fases de voo.

5.2.3.5.2 Aircraft operator that intends to accomplish APV/BaroVNAV must obtain aircraft and operators approval for the corresponding operations, in accordance with 5.1.1. If he/she does not receive such operational approval, aircraft must accomplish the LNAV minima only. In such case, only the lateral navigation based on GNSS can be used.

5.2.3.5.3 The pilots are responsible for any change on the published altitudes, concerning the temperature variation, including:

a) The altitudes of the initial and intermediate segments;

b) The altitude/decision height; and

c) The altitudes of the subsequent missed approach.

5.2.3.5.4 The APV/BARO-VNAV procedures may be accomplished only by the information on the local setting furnished by the ATS unit (directly or through the ATIS) of the aerodrome, correctly stored on the altimetry system of the aircraft. Altimetry settings coming from a remote source shall not be used on procedures on APV/Baro-VNAV.

5.2.3.5.5 The limits of the minimum and maximum of temperature authorized for the operations on Baro-VNAV will be published on the APV/Baro-VNAV Approach Procedure Chart.

5.2.3.6 Flight Plan

5.2.3.6.1 The letter “G” should be placed in block (field) 10 of the Flight Plan to indicate that the aircraft is equipped with GNSS receiver equipment appropriate for the corresponding flight phases.

NOTE: The on-board GNSS equipment does not excludes the necessity of the air navigation basic equipments, required to various types and phases of flight.

6 DISPOSIÇÕES FINAIS

6.2 Os usuários poderão contribuir para o aperfeiçoamento do emprego do GNSS, por meio da implementação dos equipamentos e de sugestões para a melhoria dos procedimentos constantes nesta AIC, as quais deverão ser encaminhadas aos Subdepartamento de Operações do Departamento de Controle do Espaço Aéreo.

6.3 Os procedimentos previstos na presente AIC somente poderão ser aplicados pelos Operadores de Aeronaves Brasileiros após a obtenção da certificação operacional correspondente, de acordo com o processo de aprovação de aeronaves e de operadores estabelecido pela Agência Nacional de Aviação Civil (ANAC), conforme mencionado no item 5.1.1.

6.4 Os casos não previstos nesta AIC serão resolvidos pelo Exmo Sr. Chefe do Subdepartamento de Operações do Departamento de Controle do Espaço Aéreo.

6.5 Esta AIC foi aprovada pelo Boletim Interno do DECEA nº de / / e substitui a AIC A12/99 de 25 NOV 99.

6 FINAL ARRANGEMENTS

6.1 The users may contribute with the improvement of the use of the GNSS, by implementing the equipments, and by suggestions for the development of the procedures mentioned in this AIC. Such suggestions must be addressed to the Operations Subdepartment of the Department of Airspace Control - DECEA.

6.2 The procedures of this AIC will only be applicable by Brazilian Aircraft Operators after obtaining the corresponding Operational Certification, in accordance of a process established by National Civil Aviation Agency (ANAC), as mentioned in 5.1.1.

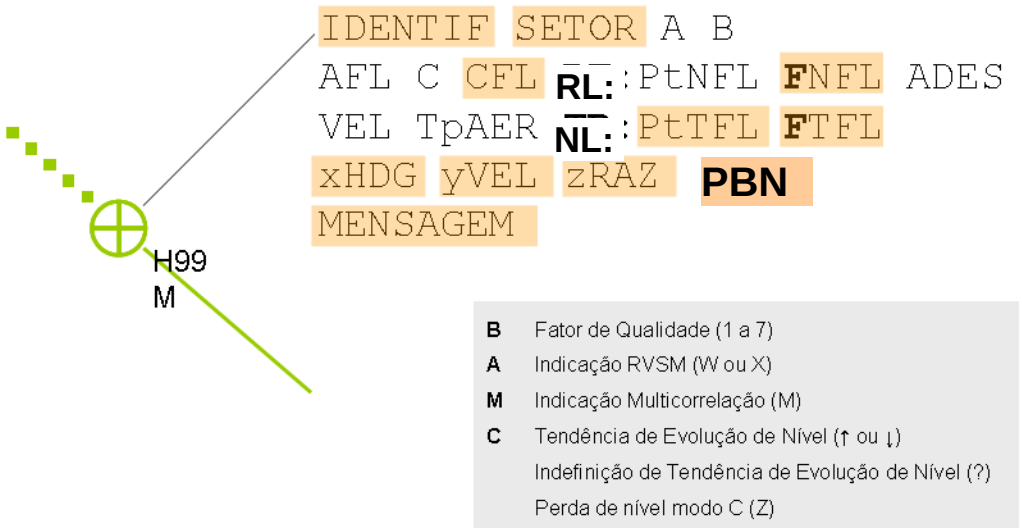
6.3 Cases not foreseen in this AIC will be resolved by the Chief of the DECEA Operations Sudepartment.

6.4 This AIC was approved by DECEA Internal Bulletin edition nr.21, dated 02 Feb 2009, and will be effective on April 09, 2009, canceling on the same date the AIC A 12/99, dated 25 NOV 1999.

APÉNDICE F / APPENDIX F

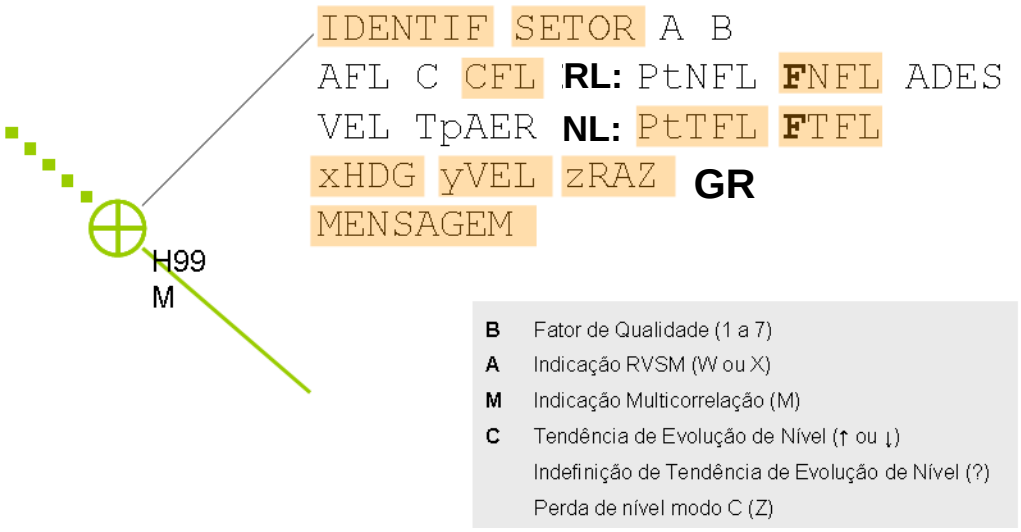
Nuevo Sistema – Sagitário
New Sagitário System

Layout del Target Radar
Layout of the Target Radar



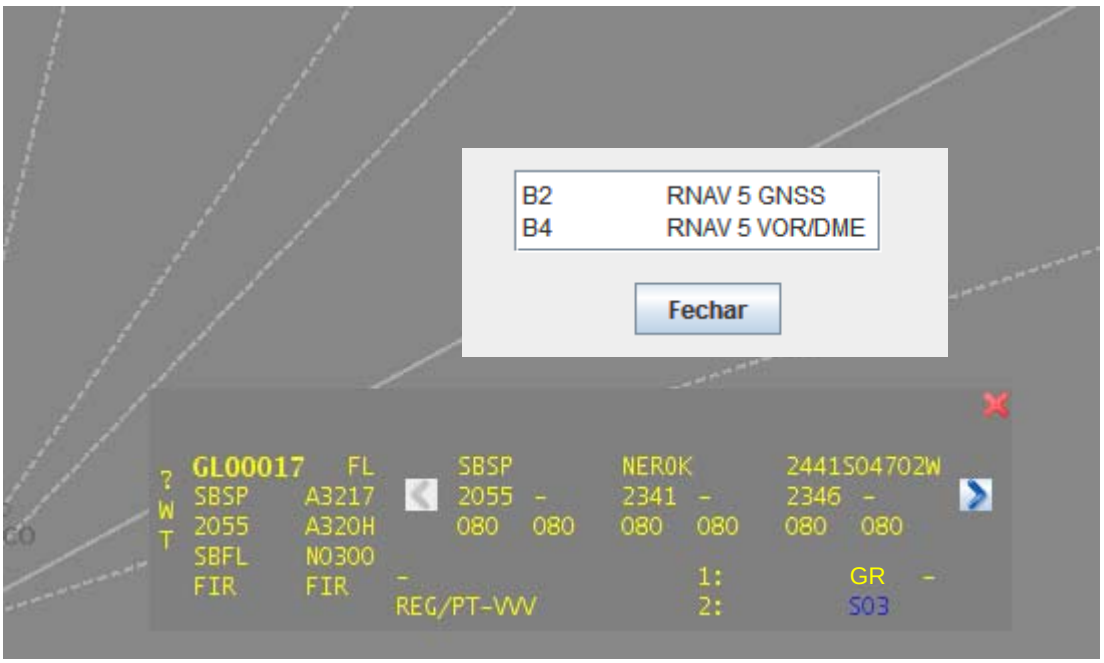
PBN – Campo en que serán insertadas las letras GR

SUGERIDA NO TREINAMENTO



PBN – G (GNSS) y R (Aprobación PBN)

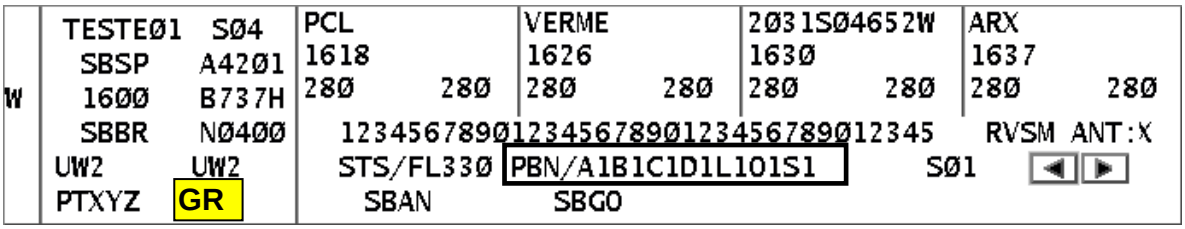
Layout da Faja de Progresión de Vuelo



Sistema Actual – X4000
Current System – X4000

Layout del Target Radar
Layout of Target Radar

Layout de la Faja de Progresión de Vuelo



APPENDIX G

APPENDIX G/ APENDICE G
NOTES ON GNSS MONITORING

ICAO requirements for status monitoring of radio navigation aids, including GNSS, are provided in Annex 10, Volume I. The requirements have recently been updated (Amendment 83 to Annex 10, applicable on 20 July 2008). In particular, section 3.7.6 of Volume I, which contained specific requirements for GNSS status monitoring, has been deleted. GNSS requirements are now included in the following general Standard addressing provision of information on the operational status of radio navigation services (Annex 10, Volume I, 2.8.1):

> *"Aerodrome control towers and units providing approach control service shall be provided with information on the operational status of radio navigation services essential for approach, landing and take-off at the aerodrome(s) with which they are concerned, on a timely basis consistent with the use of the service(s) involved."*

This Standard refers to approach control service only (as opposed to ATC service in the whole airspace) and the previous requirement (pre-Amendment 83) to provide information "without delay" is replaced by a more open requirement to provide information "on a timely basis consistent with the use of the service(s) involved".

With specific regard to the requirement to provide status monitoring for ABAS operations, the official interpretation of the standard is provided in ICAO Document 9849 (GNSS Manual), para. 5.6.5.7:

> *"A decision on whether or not to develop a status monitoring and NOTAM system for ABAS operations should be made by taking into account the nature of ABAS approvals. In many cases ABAS operations are predicated on having a full complement of traditional NAVAIDs available for back-up when ABAS cannot support service.*"

Even when status monitoring and NOTAMs need to be provided, there is no requirement to have a real-time ground based status monitoring system. NOTAMs can be based on the status information that is provided by the satellite operator and can be obtained by the State authorizing the operation, as can the information on scheduled outages. Additional real-time information to ATC could be provided by pilots reports based on status information provided by the avionics.

More generally, <u>real time monitoring of GNSS performance is an ABAS (or SBAS/GBAS/GRAS) function and no real time monitoring to ATC is required to ensure safe operations.</u>

A State could use an independent real-time ground based system as one resource-intensive way to provide status information to ATC, but in that case, a number of issues may arise. Specifically for Basic GNSS (ABAS) systems, that is systems equipped with aircraft based augmentation system based on RAIM (Receiver Autonomous Integrity Monitoring), the key issue with generating NOTAMs based on a real-time status monitoring system is the fact that all the following factors can differ between aircraft:

- the receiver RAIM algorithms of different receivers can be different;
- the satellites in view can be a different set;
- the receiver mask angle can vary;
- integration with other sensors/aids (DME/DME, baro, inertial) may or may not be available to the navigation system;
- by definition, status monitoring system cannot provide scheduled outage information, and hence even a State operating such system ultimately needs to rely on information provided by the GNSS operator.

It should be recognized that use of ground-based monitoring tools to provide real-time information to ATC may have some "psychological" advantages insofar as the air navigation service provider may feel more in control of the situation. However, this perception should not obscure the following facts:

- RAIM availability is user specific (as discussed above) and cannot be generalized;
- monitoring per se does not change anything – it is just information which cannot be projected forward (it is not a prediction);
- conflicting status information between ground-based status monitoring and avionics could create a human factors issue insofar as pilots would have to decide which source to trust;
- if, in order to resolve the conflict, pilots were asked always to trust the avionics in case of conflict, the ground-based system would be effectively proven to be useless;
- if, on the other hand, the ground based system information should be made to prevail, integrity and/or availability could be affected depending on whether the ground-based system overestimates or underestimates the quality of the signals at the aircraft's location and the capabilities of on-board navigation system.

Thus, in addition to being resource-intensive, the use of a ground-based monitoring system to provide real time information to ATC is potentially problematic insofar as it could conceivably worsen the actual performance of the overall navigation system, without providing any improvement with respect to the on-board monitoring capabilities provided by ABAS.

Finally, notwithstanding these considerations, it is noted that Annex 10, Volume I, 2.4.3 contains Recommended Practices addressing recording and retention of GNSS data, for which the use of a ground-based monitoring system is of course an option. A possible alternative (which has been adopted by at least one State) would be to make use of existing national geodesy/surveying networks (if available).

Additional uses of ground-based monitoring systems include monitoring and archiving of GNSS data to support historical data analyses and establish technical familiarity and confidence in GNSS core constellation performance.

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

Review of the work programme for the development of Advisory Circulars (AC) regarding PBN operational approvals

4.1 Under this agenda item, the Meeting noted that during the Second Workshop/Meeting of the SAM Implementation Group (SAM/IG/2) (Lima, Peru, 3 to 7 November 2008), the work programme for the development of Advisory Circulars related to PBN operational approvals was reviewed .

4.2 In this concern, the Meeting was informed that through Conclusion SAM/IG/2-5, it was agreed that the ICAO SAM Region States use an acceptable means of compliance in aircraft and operators approval for RNAV 5 operations, Advisory Circular CA 91-002 and the assistances shown in Agenda Item 3, Appendices A and B of the SAM/IG/2 Meeting report. Also, it was agreed that States publish their national regulations up to April 2009.

4.3 The Meeting also noted that the Technical Committee (CT) of the Safety Cooperation Regional System (SRVSOP), could develop three (3) Advisory Circulars and the development of the following ACs remained pending:

- ✓ CA 91-001 – Aircraft and operators approval for RNAV 10;
- ✓ CA 91-004 – Aircraft and operators approval for RNAV 1; and
- ✓ CA 91-007 – Aircraft and operators approval for RNP 1.

4.4 To this respect, the Meeting agreed that for the SAM/IG/4 the SRVPSOP CT prepare the AC programmed to be presented in this Meeting (See **Appendix A** to this part of the report).

Progress of the work carried out by the Safety Cooperation Regional System (SRVSOP), (Project RLA/99/901) regarding performance-based navigation

4.5 The Meeting noted that the SRVSOP's Technical Committee, developed the following AC:

- ✓ CA 91-008 – Aircraft and operators approval for RNP APCH operations;
- ✓ CA 91-009 – Aircraft and operators approval for RNP AR APCH operations; and
- ✓ CA 91-010 – Aircraft and operators approval for APV/baro-VNAV operations.

AC 91-008 - Aircraft and operators approval for RNP APCH

4.6 This AC establishes criteria for the aircraft and operators approval related to required navigation performance approach (RNP APCH), currently designated as RNAV $_{(GNSS)}$ and GNSS (GPS). These approaches are designed with straight segments and with vertical guidance or without it. According to Chapter 1 – Definitions of Annex 6, Part I, when these approaches use only lateral guidance, they are classified as a non-precision approach operations (NPA) and when they use both types of guidance, lateral and vertical, they are classified as approach operations with vertical guidance (APV), since they do not meet the requirements established for precision approach and landing operations. This document provides only the approval criteria related to lateral navigation. Criteria corresponding to vertical navigation for this kind of approach, when designed with this application, are described in AC 91-010.

AC 91-009 - Aircraft and operators approval for RNP AR APCH operations

4.7 This AC provides the approval criteria for aircraft and operators for RNP authorization required approach (RNP AR APCH). The AIP should clearly indicate the navigation application is RNP AR APCH and mandatory clearance is required. At present, these procedures are designated as RNAV $_{(RNP)}$. This kind of approach uses lateral and vertical guidance too, but does not meet the requirements established for precision approach and landing operations; thus, they are also classified as APV operations. An RNP AR APCH operation is designed when a straight-in approach is not possible operationally. There are three elements in the criteria of the procedures design of an RNP AR APCH approach which should be used only in case there is a specific operational need or benefit. Consequently, an operator may be authorized to all or any of the following subgroups of these types of procedures:

- ✓ Ability 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 requires RNP less than 1.0.

AC 91-010 - Aircraft and operators approval for APV/baro-VNAV operations

4.8 This AC provides the approval criteria for aircraft and operators for approach operations with vertical guidance/barometric vertical navigation (APV/baro-VNAV). This AC establishes only the criteria for approval of vertical navigation of RNP APCH approaches, when this type of navigation is required in those approaches. Aircraft approved under AC 91-009 (RNP AR APCH), do not require a new approval according to AC 91-010 (APV/baro-VNAV) since they comply with all requirements related with vertical navigation.

4.9 Following with the evaluation of advisory circulars, the meeting analysed the convenience to include AC 91-010 as an appendix to CA 91-008, taking into consideration that APV/baro-VNAV are part of RNP APCH approaches (CA 91-008) when these approval are designed with barometric vertical guidance. However, it was agreed to maintain CA 91-010 as a separate document to facilitate the handling of the same and develop a paragraph in both AC to explain in which case the criteria of both documents should be used on the whole.

4.10 Implementation in the SAM Region of RNP APCH, RNP AR APCH and APV/baro-VNAV operations requires the participation of every State and the need to harmonize requirements and procedures of this type of operations.

4.11 Before authorizing RNP APCH, RNP AR APCH and APV/baro-VNAV operations, the States should include in their national regulations, the rules related to these navigation specifications and develop the procedures related to the aircraft and operations approval.

4.12 The Meeting noted that currently, the Regional System (Project RLA/99/90) has already developed Latin American Aeronautical Regulations (LAR) as regards Annexes 1, 6 and 8 and the corresponding manuals for operations, airworthiness inspectors with the purpose of establishing common requirements and procedures in the region.

4.13 With regard to the publication of RNAV 5 operations, the meeting determined that most States had not yet published such regulations and AC. In this sense, it agreed to extend the target date to **5 October 2009** for the publication of national regulations and CA related with RNAV 5. Also, the Meeting agreed that States publish until the same date **(05 October 2009)** the national regulations and AC corresponding to RNP APCH, RNP AR APCH and APV/baro-VNAV operations.

4.14 In view of the aforementioned, and once the meeting reviewed and incorporated improvements in AC presented, it formulated the following Conclusion:

Conclusion SAM/IG/3-4 Advisory Circulars CA 91-008, CA 91-009 and CA 91-010

That States of the SAM Region:

a) use as acceptable means of compliance in aircraft approval and exploiters for RNP APCH, RNP AR APCH and APV/baro-VNAV operations, Advisory Circulars CA 91-008, CA 91-009 and CA 91-010, shown in **Appendices B, C and D,** respectively to this part of the report; and

b) publish the corresponding national regulations until **5 October 2009**.

4.15 In order to keep the guidance material standardized, the meeting agreed to incorporate CA 91-002 (RNAV 5), several improvements which were included in CA 91-008, CA 91-009 and CA 91-010. **Appendix E** to this part of the Report presents AC 91-002 amended.

Review of the survey form about aircraft PBN capability

4.16 On this agenda item, the meeting was informed that during the Second Workshop/Meeting of SAM Implementation (SAM/IG/2) (Lima, Peru, 3 to 7 November 2008), the proposal to develop a survey addressed to all SAM States was approved, identifying 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 on Agenda Item 2 of the SAM/IG/2.

4.17 Once the TC developed the AC 91-008 (RNP APCH) and AC 91-009 (RNP AR APCH), it determined that it was necessary to formulate the survey form to include RNP AR APCH operations, in view that these operations have different requirements with regard to those requirements required for RNP APCH operations.

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

RNP VALUES

4.19 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

4.20 The characteristics of the procedures are the following:

RNP APCH

- According to paragraph 1.1.4 f), Chapter 1, Section 1, Part II of Doc 8168 – Construction of Visual and Instrument Flight Procedures, these approaches are used to support RNAV approach operations, up to RNP 0,3, designed 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

4.21 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.

- *Ability 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 requires RNP less than 1.0.*

4.22 These approaches require to be designed with positive barometric vertical guidance. That is to say, 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

4.23 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.

ADDDITIONAL REQUIREMENTS FOR 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 feer 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).

4.24 In view of the aforementioned, the meeting agreed to modify the survey form to include an additional box, which title reflects RNP AR APCH operations. This amended form shall be immediately sent to States to continue with the data collection process. **Appendix F** to this part of the report presents the revised form.

Progress in the survey on aircraft PBN capacity

4.25 With regard to the progress in PBN aircraft capacity, the meeting noted that only Ecuador, French Guiana and Peru have not submitted information on PBN aircraft.

4.26 On this regard, the meeting analysed the difficulties of States to timely and adequately complete the information requested. In this connection, it agreed to standardise the delivery dates of the results for 31 July 2009. By that date, States shall submit the corresponding results to aircraft operating in:

- aircraft **commercially** operating with MTOW upper than 5700 Kg;
- aircraft **commercially** operating with less weight.
- General aviation

4.27 On the other hand, note was taken that Several States have commercial air transport users with licenses either in their State or in other States, in these cases it was agreed that the operator State should complete the survey for all aircraft included in specifications related to operations of air services operators, independently if they have national or foreign license.

4.28 For the cases or aircraft exchange the State of license shall be responsible to complete the form for aircraft which have license in their State, prior coordination with the operator State in order not to repeat the information.

Appendix A

Revised Job Schedule for the development of CAs in respect to PBN approvals

Navigation specifications	CA	Titles	CA to be presented in
RNAV 10 (designated and authorized as RNP 10)	CA 91-001	Aircraft and operators approval for RNP 10 operations	**SAM/IG/4** 19 to 23 october 2009
RNAV 5	CA 91-002	Aircraft and operators approval for RNAV 5 operations	**SAM/IG/2** 03 to 07 november 2008
RNAV 2	CA 91-003	Aircraft and operators approval for RNAV 2 operations	**SAM/IG/4** 19 to 23 october 2009
RNAV 1	CA 91-004	Aircraft and operators approval for RNAV 1 operations	**SAM/IG/4** 19 to 23 october 2009
RNP 4	CA 91-005	Aircraft and operators approval for RNP 4 operations	**SAM/IG/5** April 2010
RNP 2	CA 91-006	Aircraft and operators approval for RNP 2 operations	**SAM/IG/5** April 2010
RNP 1	CA 91-007	Aircraft and operators approval for RNP 1 operations	**SAM/IG/4** 19 to 23 october 2009
RNP APCH	CA 91-008	Aircraft and operators approval for RNP APCH operations	**SAM/IG/3** 20 to 24 april 2009
RNP AR APCH	CA 91-009	Aircraft and operators approval for RNP AR APCH operations	**SAM/IG/3** 20 to 24 april 2009
APV/baro-VNAV	CA 91-010	Aircraft and operators approval for APV/baro-VNAV operations	**SAM/IG/3** 20 to 24 april 2009

APPENDIX B

ADVISORY CIRCULAR

AC	**:**	**91-008**
DATE	**:**	**06/04/09**
REVISION	**:**	**Original**
ISSUED BY	**:**	**SRVSOP**

SUBJECT: APPROVAL OF AIRCRAFT AND OPERATORS FOR RNP APPROACH (RNP APCH) OPERATIONS

1. PURPOSE

This advisory circular (AC) establishes the requirements for RNP APCH (lateral navigation only) approval for aircraft and operators. The requirements for vertical barometrical navigation (baro-VNAV) of a RNP APCH approach are detailed on CA 91-010 (APV/baro-VNAV). Present CA's 91-008 criteria altogether with CA's 91-010 establish the requirements for operations RNP APCH with baro-VNAV.

An operator may use other means of compliance, provided they are acceptable for the civil aviation administration (CAA).

Use of the future tense of the verb or use of the term "must" applies to an applicant or operator that chooses to meet the criteria established in this AC.

2. SECTIONS RELATED TO THE LATIN AMERICAN AERONAUTICAL REGULATIONS (LARs) OR EQUIVALENT

LAR 91: Section 91.880 (b) or equivalent

LAR 121: Section 121.995 (b) or equivalent

LAR 135: Section 135.565 (c) or equivalent

3. RELATED DOCUMENTS

Annex 6	Aircraft operations
Annex 10	Aeronautical telecommunications
	Volume I: Radio navigation aids
Doc 9613	Performance-based navigation manual (PBN)
Doc 8168	Aircraft operations
	Volume I: Flight procedures
	Volume II: Construction of visual and instrument flight procedures
AMC 20-27	Airworthiness approval and operational criteria for RNP APPROACH (RNP APCH) operations including APV BARO-VNAV operations
FAA AC 90-105	Approval guidance for RNP operations and barometric vertical navigation in the U.S. National Airspace System

4. DEFINITIONS AND ABBREVIATIONS

4.1 Definitions

a) **Primary field of view.-** For purposes of this AC, the primary field of view is within 15 degrees of the primary line of sight of the pilot.

b) **Navigation specifications**.- Set of aircraft and flight crew requirements to support performance-based navigation operations within a defined airspace. There are two classes of navigation specifications: RNAV and RNP. The RNAV specification does not include on-board performance control and alert requirements. The RNP specification includes on-board performance control and alert requirements.

c) **Performance-based navigation (PBN)**.- Performance-based area navigation requirements applicable to aircraft conducting operations on an ATS route, in an instrument approach procedure, or a designated airspace.

Performance requirements are expressed in the navigation specifications (RNAV and RNP specifications) in terms of the precision, integrity, continuity, availability, and functionality required for the intended operation within the context of a particular airspace concept.

d) **Area navigation (RNAV)**.- Navigation method that permits aircraft operations in any desired flight path within the coverage of ground-based or space-based navigation aids, or within the capability limits of autonomous aids, or a combination of the two.

Area navigation includes performance-based navigation as well as other operations not contemplated in the performance-based navigation definition.

e) **RNP operations**.- Aircraft operations that use an RNP system for RNP applications.

f) **Required navigation performance (RNP)**.- Statement of the navigation performance required to operate in a defined airspace.

g) **Way-point (WPT).-** A specified geographical location used to define an area navigation route or the flight path of an aircraft employing area navigation. Way-points are identified as either:

Fly-by way-point.- A way-point that requires turn anticipation to allow tangential interception of the next segment of a route or procedure.

Flyover way-point.- A way-point at which a turn is initiated in order to join the next segment of a route or procedure.

h) **Initial approach fix (IAF).-** Fix that marks the beginning of the initial segment and the end of the arrival segment, if applicable. In RNAV application, this fix is normally defined as a “fly-by fix”.

i) **Flight management system (FMS)**.- Integrated system made up by an on-board sensor, a receiver, and a computer with navigation and aircraft performance databases, capable of providing performance values and RNAV guidance to a display and automatic flight control system.

j) **Global positioning system (GPS)**.- The U.S. global navigation satellite system (GNSS) is a satellite-based radio navigation system that uses precise distance measurements to determine the position, speed and time anywhere in the world. The GPS is made up by the spatial, control and user elements. The spatial element is made up by at least 24 satellites in 6 orbiting planes. The control element consists of 5 monitoring stations, 3 ground antennas, and one main control station. The user element consists of antennas and receivers that provide the user with position, speed, and precise time information.

k) **Global navigation satellite system (GNSS)**.- Generic term used by ICAO to define any global positioning and timing system made up by one or more main satellite constellations, such as the GPS and the global navigation satellite system (GLONASS), aircraft receivers, and several integrity surveillance systems, including aircraft-based augmentation systems (ABAS), satellite-based augmentation systems (SBAS), such as the wide area augmentation system (WAAS) and ground-based augmentation systems (GBAS), such as the local area augmentation system (LAAS).

Distance information will be provided, at least in the immediate future, by GPS and GLONASS.

l) **RNP system**.- Area navigation system that provides on-board performance control and alert.

m) **RNP value**.- The RNP value designates the lateral performance requirement associated with a procedure. Examples of RNP values are: RNP 0.3 and RNP 0.15.

n) **Receiver autonomous integrity monitoring (RAIM)**.- Technique used in a GPS receiver/processor to determine the integrity of its navigation signals, using only GPS signals or enhanced GPS signals with barometric altitude data. This determination is achieved by a consistency check between redundant pseudo-range measurements. At least one satellite in addition to those required must be available to obtain the navigation solution.

4.2 Abbreviations

a)	AAC	Civil Aviation Administration
b)	ABAS	Aircraft-based augmentation system
c)	AIP	Aeronautical information publication
d)	AP	Autopilot
e)	APCH	Approach
f)	APV	Approach procedure with vertical guidance
g)	APV/baro-VNAV	Approach operations with vertical guidance/Barometric vertical navigation
h)	AR	Authorisation required
i)	AIRAC	Aeronautical information regulation and control
j)	AC	Advisory circular (FAA)
k)	AFM	Aircraft flight manual
l)	AMC	Acceptable means of compliance
m)	ATC	Air traffic control
n)	ATS	Air traffic service
o)	baro-VNAV	Barometric vertical navigation
p)	CA	Advisory circular (SRVSOP)
q)	CDI	Course deviation indicator
r)	CDU	Control display unit
s)	DME	Distance measuring equipment
t)	DME/DME	Distance measuring equipment/distance measuring equipment
u)	DME/DME/IRU	Distance measuring equipment/distance measuring equipment/inertial reference unit

v)	DTK	Desired track
w)	EASA	European Aviation Safety Agency
x)	EHSI	Enhanced horizontal situation indicator
y)	ETA	Estimated time of arrival
z)	FAA	United States Federal Aviation Administration
aa)	FAF	Final approach fix
bb)	FD	Flight director
cc)	FMS	Flight management system
dd)	Fly-by WPT	Fly-by waypoint
ee)	Flyover WPT	Flyover waypoint
ff)	FSD	Maximum deflection
gg)	FTE	Flight technical error
hh)	GBAS	Ground-based augmentation system
ii)	GNSS	Global navigation satellite system
jj)	GLONAS	Global navigation satellite system
kk)	GPS	Global positioning system
ll)	IAF	Initial approach fix
mm)	IAP	Instrument approach procedure
nn)	IFR	Instrument flight rules
oo)	IRU	Inertial reference unit
pp)	LAAS	Local area augmentation system
qq)	LAR	Latin American Aeronautical Regulations
rr)	LNAV	Lateral navigation
ss)	LOA	Letter of authorisation/letter of acceptance
tt)	LP	Localizer performance
uu)	LPV	Localizer performance with vertical guidance
vv)	MAPt	Missed approach point
ww)	MEL	Minimum equipment list
xx)	NAVAIDS	Navigation aids
yy)	2D navigation	2D area navigation that only uses the capabilities on the horizontal plane
zz)	NDB	Non-directional beacon
aaa)	NSE	Navigation system error
bbb)	NOTAM	Notice to airmen
ccc)	OACI	International Civil Aviation Organization
ddd)	OCA/H	Obstacle clearance altitude/height
eee)	OEM	Original equipment manufacturer
fff)	OM	Operations Manual

ggg)	OpSpecs	Operational specifications
hhh)	PANS-OPS	Procedures for air navigation services – Aircraft operations
iii)	PBN	Performance-based navigation
jjj)	PDE	Path definition error
kkk)	PF	Pilot flying the aircraft
lll)	PFD	Primary flight displays
mmm)	POH	Pilot operations manual
nnn)	PM	Pilot monitoring the aircraft
ooo)	PNF	Pilot not flying the aircraft
ppp)	RAIM	Receiver autonomous integrity monitoring
qqq)	RF	Constant radius to fix arc
rrr)	RNAV	Area navigation
sss)	$RNAV_{(GNSS)}$	GNSS (GPS)-based RNP APCH approaches
ttt)	RNP	Required navigation performance
uuu)	RNP APCH	Required navigation performance approach
vvv)	RNP AR APCH	Required navigation performance authorization required approach
www)	SBAS	Satellite-based augmentation system
xxx)	SL	Service letters
yyy)	SRVSOP	Regional Safety Oversight Cooperation System
zzz)	STC	Supplementary type certificate
aaaa)	TCDS	Type certificate data sheet
bbbb)	TSE	Total navigation system error
cccc)	TSO	Technical standard order
dddd)	VMC	Visual flight meteorological conditions
eeee)	VNAV	Vertical navigation
ffff)	VOR	VHF omnidirectional radio range
gggg)	VPA	Vertical path angle
hhhh)	WAAS	Wide area augmentation system
iiii)	WGS	World geodetic system
jjjj)	WPT	Waypoint
kkkk)	XTK	Cross-track

5. INTRODUCTION

5.1 According to Doc 9613 of the International Civil Aviation Organization (ICAO) - Manual on Required Navigation Performance (PBN), there are two types of required navigation performance (RNP) specifications for approach operations: RNP approach (RNP APCH) and RNP with authorisation required approach (RNP AR APCH).

5.2 This AC establishes only lateral navigation requirements (2D navigation) of RNP APCH approaches which include RNAV $_{(GNSS)}$ or present GNSS approaches, designed with direct segments only.

5.3 The requirements for approaches with curved segments or *published arcs,* also known as *radius to fix segments (RF segments),* are specified in AC 91-009 of the Regional Safety Oversight Cooperation System (SRVSOP) – Approval of aircraft and operators for RNP approach procedures requiring authorisation (RNP AR APCH).

5.4 According to Annex 6 to the Convention, when RNP APCH procedures do not include barometric vertical guidance, they are classified as non-precision approach procedures (NPA). On the other hand, when RNP APCH operations include barometric vertical guidance, they are classified as approach operations with vertical guidance (APV).

5.5 Baro-VNAV systems are optional capabilities that do not constitute a minimum requirement for flying RNAV$_{(GNSS)}$ or GNSS approaches using a line of LNAV minima.

5.6 Operations with localizer performance (LP) and localizer performance with vertical guidance (LPV) are not covered by this AC and will be the subject of another SRVSOP AC.

5.7 This document also offers general considerations on the approval of autonomous and multi-sensor aircraft systems, including their functional, precision, integrity, continuity, and restriction requirements, together with operational considerations.

5.8 Autonomous and multi-sensor RNP systems that use GNSS (GPS) and that comply with AMC 20-27 of the European Aviation Safety Agency (EASA) and with the advisory circulars (AC) of the United States Federal Aviation Administration (FAA): AC 90-105, AC 20-138A, AC 20-130A or TSO C 115b/ETSO C 115b, meet the ICAO RNP APCH navigation specification.

Nota.- *Multi-sensor systems may use other combinations of sensors, such as distance measuring equipment/distance measuring equipment (DME/DME) or distance measuring equipment/distance measuring equipment/inertial reference unit (DME/DME/IRU), that provide an acceptable navigation performance for RNP APCH operations; however, these cases are limited due to the increased complexity of navigation aid (NAVAID) infrastructure requirements and assessment, and are not practical or profitable for general application.*

5.9 The material described in this AC has been developed based on the following document:

- ✓ Chapter 5, Volume II, Part C of ICAO Doc 9613 – RNP APCH Implementation.

5.10 Inasmuch as possible, this AC has been harmonised with:

- ✓ EASA AMC 20-27 - Airworthiness approval and operational criteria for RNP APPROACH (RNP APCH) operations including APV BARO-VNAV operations; and
- ✓ FAA AC 90-105 - Approval guidance for RNP operations and barometric vertical navigation in the U.S. National Airspace System.

Note.- *Notwithstanding harmonisation efforts, operators shall note the differences between this AC and the aforementioned documents when requesting an authorisation from the corresponding Administrations.*

6. GENERAL CONSIDERATIONS

6.1 Radio aid infrastructure.-

a) The global navigation satellite system (GNSS) is the primary navigation system supporting RNP APCH procedures.

b) In baro-VNAV RNP APCH operations procedure design is based on the use of barometric altimetry provided by an aircraft RNP system whose capabilities support the required operation. The procedure design must take into account the performance and functional capabilities required in SRVSOP AC 91-010 – Approval of aircraft and operators for approach operations with vertical guidance/barometric vertical navigation (APV/baro-VNAV), or equivalent documents.

c) The airspace authority must consider acceptance of the risk of losing RNP APCH capacity in multiple aircraft due to failure or loss of the control and alert function on board the aircraft (for example, spaces with no receiver autonomous integrity monitoring (RAIM) coverage).

6.2 **Obstacle clearance.-**

6.2.1 RNP APCH operations without baro-VNAV guidance.-

a) Doc 8168 (PANS-OPS), Volume II – Construction of visual and instrument flight procedures, provides detailed obstacle clearance guidelines. The missed approach procedure may be supported either by RNAV or by conventional segments (*e.g.*, segments based VHF onmidirectional radio range (VOR), distance measuring equipment (DME), or non-directional radio beacon (NDB)).

b) Procedure designs must take into account the lack of vertical navigation (VNAV) capability of the aircraft.

6.2.2 RNP APCH operations with baro-VNAV guidance.-

a) Baro-VNAV applies when vertical guidance and information is provided to the flight crew during instrument approach procedures containing a vertical path defined by a vertical path angle (VPA).

b) Doc 8168 (PANS-OPS), Volume II – Construction of visual and instrument flight procedures, provides detailed obstacle clearance guidelines. The missed approach procedure may be supported either by RNAV or conventional segments (*e.g.,* segments based on VOR, DME, NDB).

6.3 **Publications.-**

a) Instrument approach charts will clearly identify the RNP APCH application as $RNAV_{(GNSS)}$.

b) For RNP APCH operations without baro-VNAV, the procedure design will be based on normal descent profiles, and the charts will identify minimum altitude requirements for each segment, including a lateral navigation obstacle clearance altitude/height (LNAV OCA/H).

c) For RNP APCH operations with baro-VNAV, the charts will follow the standards of Annex 4 to the Convention on International Civil Aviation for the designation of an RNAV procedure where the vertical path is specified by a VPA. The chart designation will be consistent with said Annex and a lateral and vertical navigation obstacle clearance altitude/height will be issued (LNAV/VNAV OCA/H).

d) When the missed approach segment is based on conventional methods, the navigation aids (NAVAIDs) or the aircraft means of navigation that are necessary to conduct the missed approach will be identified in the relevant publications.

e) The navigation information contained in the aeronautical information publication (AIP) that is applicable to the supporting procedures or NAVAIDs will meet the requirements of Annexes 15 and 4 to the Convention on International Civil Aviation (as appropriate). Procedure charts will provide sufficient data to support the verification of the navigation database by the flight crew (including waypoint names (WPT), tracks, distances for each segment and the VPA).

f) All procedures will be based on the coordinates of the world geodetic system 84 (WGS 84).

6.4 **Air traffic service (ATS) communication and surveillance.-**

a) RNP APCH operations do not include specific ATS communication and surveillance requirements. Adequate obstacle clearance is obtained through aircraft performance and operational procedures. When confident on the use of radar to support contingency procedures, it must be demonstrated that its performance is adequate for this purpose. The radar service requirement will be identified in the AIP.

b) Appropriate radio phraseology will be published for RNP APCH operations.

c) Air traffic control (ATC) is expected to be familiar with aircraft VNAV capabilities, as well as with aspects concerning altimetry setting and the effect of temperature on the integrity of baro-VNAV RNP APCH operations.

d) The particular hazards of the terminal area and the approach must be assessed, as well as the effect of contingency procedures following a multiple loss of RNP APCH capability.

6.5 **Navigation facts associated with flight phases of RNP APCH approaches.-**

a) According to ICAO Doc 9613, navigation facts associated with phases of flight approach RNP APCH are the following:

1)	Initial segment:	RNP 1.0
2)	Middle segment:	RNP 1.0
3)	Final segment:	RNP 0.3
4)	Unsuccessfull approach segment:	RNP 1.0

6.6 **Additional considerations.-**

a) Consideration will be given to the fact that many aircraft are capable of executing the holding pattern manoeuvre using an RNP system.

7. DESCRIPTION OF THE NAVIGATION SYSTEM

a) **Lateral navigation (LNAV)**.- In LNAV, RNP equipment enables the aircraft to fly in accordance with appropriate routing instructions along a path defined by waypoints maintained in an on-board navigation database.

Note.- *Normally, LNAV is a mode of flight guidance systems where the RNP equipment provides path steering commands to the flight guidance system that controls flight technical error (FTE) through either manual pilot control with a path deviation display or through FD or AP coupling.*

8. AIRWORTHINESS AND OPERATIONAL APPROVAL

8.1 In order to get an RNP APCH authorization, a commercial air transport operator shall obtain two types of approval:

a) an airworthiness approval from the State of Registry; (see Article 31 of the Chicago Convention and paragraphs 5.2.3 and 8.1.1 of Annex 6, Part I); and

b) an operational approval from the State of the Operator (see paragraph 4.2.1 and Attachment F to Annex 6, Part I).

8.2 For general aviation operators, the State of Registry will determine if the aircraft meets the applicable RNP APCH requirements and will issue the operational authorisation (*e.g.,* a letter of authorization – LOA) (see paragraph 2.5.2.2 of Annex 6, Part II).

8.3 Before submitting the application, operators shall review all the aircraft qualification requirements. Compliance with airworthiness requirements or the installation of the equipment, by themselves do not constitute operational approval.

9. AIRWORTHINESS APPROVAL

9.1 General.-

a) The following airworthiness criteria apply to the installation of RNP systems required for RNP APCH

operations:

1) This AC uses FAA AC 20-138/AC 20-138A (autonomous GPS system) or AC 20-130A (multi-sensor system) as a basis for the airworthiness approval of a GNSS-based RNP system.

2) For baro-VNAV operations, AC 20-129 will be used, as established in SRVSOP AC 91-010.

9.2 Aircraft and system requirements.-

a) Aircraft approved to conduct (GPS) RNAV or GPS approaches meet the performance and functional requirements of this AC for RNP APCH instrument approaches without radius to fix (RF) segments.

b) Aircraft that have a statement of compliance with respect to the criteria contained in this AC or equivalent documents in the flight manual (AFM), AFM supplement, pilot operations handbook (POH), or the avionics operating manual, meet the performance and functional requirements of this AC.

c) Aircraft that have a statement by the manufacturer documenting compliance with the criteria of this AC or equivalent documents meet the performance and functional requirements of this document. This statement will include the airworthiness grounds for such compliance. The equipment or aircraft manufacturer will determine compliance with sensor requirements, while functional requirements may be determined by the manufacturer or through an inspection by the operator.

d) If the RNP facility is based on an autonomous GNSS system, the equipment shall comply in keeping with technical standard order (TSO) C129a/ETSO-C129a Class A1 (or subsequent revisions) or with TSO-C146a/ETSO-C146a Class Gamma and Operational Class 1, 2, or 3 (or subsequent revisions) and shall meet the functional requirements of this document.

e) If the RNP facility is based on GNSS sensor equipment used in a multi-sensor system (*e.g.,* flight management system (FMS)), GNSS sensors shall be approved in keeping with TSO-C129 ()/ETSO-C129 () Classes B1, C1, B3, C3 (or subsequent revisions) or TSO-C145 ()/ETSO-C145 () Class Beta and Operational class 1, 2 or 3 (or subsequent revisions) and shall meet the functional requirements of this document.

f) Multi-sensor systems using GNSS shall be approved in keeping with AC 20-130A or TSO-C115b/ETSO-C115b and shall meet the functional requirements of this document.

Note.- *The GNSS equipment approved by TSO-C129a/ETSO-C129a must fulfil the system functions specified in this document. Furthermore, integrity shall be provided through an aircraft-based augmentation system (ABAS). It is advisable that GNSS receivers include pseudorange hop detection and message health code verification*.

Note.- *Multi-sensor systems using a DME/DME or DME/DME/IRU as single means of RNP compliance are not authorised to conduct RNP APCH operations.*

9.3 Performance and functional requirements of RNP systems

a) **Precision.-**

1) Total navigation system error (TSE) in the lateral and longitudinal dimensions (along the flight path) for an RNP APCH procedure must be within:

(a) ± 1 NM for at least 95 percent of the total flight time in the initial and intermediate approach segments and in the missed approach.

Note.- *There is no specific RNP precision requirement for the missed approach if this segment is based on conventional NAVAIDs (VOR, DME, NDB) or in dead reckoning navigation.*

(b) ± 0.3 NM for at least 95 percent of the total flight time in the final approach segment.

2) In order to meet the precision requirement, the flight technical error (FTE) (95%) shall not exceed:

(a) 0.5 NM in the initial, intermediate, and missed approach segments of an RNP APCH procedure; and

(b) 0.15 NM in the final approach segment of the procedure.

Note .- *The use of a deviation indicator with a maximum deflection (FSD) of 1 NM in the initial, intermediate, or missed approach segment and an FSD of 0.3 NM in the final approach segment is considered to be an acceptable means of compliance.*

3) An acceptable means of compliance with the precision requirements described in the previous paragraphs is having approved RNP systems in keeping with the 2D navigation precision criteria established in AC 20-138, AC 20-138A or AC 20-130A.

b) **Integrity.-** The malfunction of the aircraft navigation equipment causing the TSE to exceed 2 times the RNP value is classified as a major failure condition according to airworthiness regulations (*e.g.,* 10^{-5} per hour).

c) **Continuity.-** Loss of a function is classified as a minor failure condition if the operator can reverse to a different navigation system and proceed to an suitable airport. If the missed approach procedure is based on conventional NAVAIDs (*e.g.,* VOR, DME, NDB), the associated navigation equipment must be installed and operational. For RNP APCH operations, at least one RNP navigation system is required.

Note.- *From the operational point of view, the operator must develop contingency procedures in case of loss of the RNP APCH capability during approach.*

d) **Performance control and alert.-** During operations in the initial, intermediate, and missed approach segments of an RNP APCH procedure, the RNP system or the RNP in combination with the pilot, shall provide an alert if the precision requirement is not met or if the probability of the lateral TSE exceeding 2 NM is greater than 10^{-5}. During operations in the final approach segment, the RNP system or the RNP system in combination with the pilot shall provide an alert if the precision requirement is not met or if the probability of the lateral TSE exceeding 0.6 NM is greater than 10^{-5}.

e) **Signal-in-space.-** During operations in the initial, intermediate, and missed approach segments of an RNP APCH procedure, the aircraft navigation equipment will provide an alert if the probability of error of the signal-in-space results in a lateral position error greater than 2 NM exceeding 10^{-7} per hour (Table 3.7.2.4-1 of Annex 10 to the Convention). During operations in the final approach segment, the aircraft navigation equipment will provide an alert if the probability of error of the signal-in-space results in a navigation system error greater than 0.6 NM exceeding 10^{-7} per hour (Table 3.7.2.4-1 of Annex 10 to the Convention).

Note.- *Compliance with the performance control and alert requirement does not imply automatic control of FTE. The on board performance control and alert function must consist of at least one navigation system error (NSE) control and alert algorithm, and a lateral deviation display allowing the flight crew to control the FTE. To the extent operational procedures are used to control the FTE, crew procedures, equipment and facility characteristics, these are assessed by their effectiveness and equivalence, as described in the functional requirements and operational procedures. The path definition error (PDE) is considered to be insignificant due to the quality assurance process and flight crew procedures.*

f) **Path definition.-** Aircraft performance is assessed around the path defined by the published procedure and by document RTCA/DO-236B Sections 3.2.5.4.1 and 3.2.5.4.2

g) **Navigation display functionality requirements.-** The following navigation displays and functions are required, according to FAA AC 20-130 and AC 20-138 or equivalent advisory material. Navigation data, including a to/from indication and a failure indicator must appear in a lateral deviation display (course deviation indicator (CDI), enhanced horizontal situation indicator (EHSI)) and/or a navigation map display. These displays must be used as primary flight instruments for aircraft navigation, anticipation of a manoeuvre, and failure/condition/integration indication. The aforementioned non-numerical lateral deviation displays must have the following attributes:

1) displays must be visible to the pilot and must be located in the primary field of view of the pilot when looking ahead along the flight path.

2) the scale of the lateral deviation display must be consistent with any alert and annunciation limit.

3) the lateral deviation alert must have an adequate FSD for the current flight phase and must be based on the TSE requirement. Scales of ± 1 NM for the initial, intermediate, and missed approach segments, and of ± 0.3 NM for the final segment are acceptable.

4) the scale of the display may be automatically established by logical default, or established at a value obtained from a navigation database. The FSD value must be known or must be available for display to the pilot, in a proportional ratio to approach values.

5) as an alternate means, a navigation map display must provide a functionality equivalent to a lateral deviation display with the appropriate map scales (scales can be established manually by the pilot) and provide a functionality equivalent to a lateral deviation display. In order for it to be approved, the navigation map display must show compliance with TSE requirements and be located in the primary field of view of the pilot.

6) the lateral deviation display must be automatically enslaved to the calculated RNP path. It is advisable that the lateral deviation display course selector be automatically enslaved to the calculated RNP path.

Note.- *This does not apply to facilities where an electronic map display contains a graphical display of the flight path and of path deviation.*

7) enhanced navigation displays (*e.g., electronic map displays* or enhanced HSI) to increase situational awareness, control navigation and verify the approach (flight plan verification) could become mandatory if the RNP facility does not provide the information display necessary for the crew to perform these tasks.

h) **System capabilities.-** The following system capabilities are required as a minimum:

1) the capacity to continuously show the pilot flying the aircraft (PF) the desired/calculated RNP path and the position of the aircraft relative to the path, on the primary flight instruments for aircraft navigation (primary navigation display). For operations where the minimum flight crew required is two pilots, a means must be available for the pilot not flying the aircraft (PNF) (pilot monitoring the aircraft (PM)) to check the desired path and the position of the aircraft relative to the path.

2) a navigation database containing current navigation data officially published by the CAA, which can be updated in keeping with the aeronautical information regulation and control cycle (AIRAC) and from/into which approach procedures can be retrieved and entered in the RNP system. The stored database resolution must be sufficient to achieve the required track-keeping precision. The database must not allow modifications to the stored data by the pilot.

3) the means to show the pilot the validity period of navigation data.

4) the means to retrieve and display information stored in the navigation database regarding individual waypoints and NAVAIDs, in order to permit the pilot to verify the route to be flown.

5) the capacity to load, from the database to the RNP system, the complete approach to be flown. The approach must be loaded by its name from the database to the RNP system.

6) the means to display the following items, either in the primary field of view of the pilot or on a readily accessible display page:

   (a) The identification of the active (to) WPT;

   (b) the distance and course to the active (to) WPT; and

   (c) the ground speed or time to the active (to) WPT.

7) the means to display the following items on a readily accessible display page:

   (a) the distance between the WPTs of the operational flight plan;

   (b) the distance to be flown;

   (c) the distances along the track; and

   (d) the type of active navigation sensor, if there is another type of sensor in addition to the GNSS sensor.

8) the capacity to execute the “direct to” function.

9) the capacity to provide an automatic order of segments for display to the pilots.

10) the capacity to execute RNP instrument approach procedures (IAP) extracted from the aircraft database, including the capability of executing flyover and fly-by turns.

11) the capacity to automatically execute segment transitions and maintaining consistent tracks with the following ARINC 424 path terminators or their equivalent:

(a) Initial fix (IF)

(b) track to fix (TF)

(c) direct to fix (DF)

Note.- *Path terminators are defined in ARINC Specification 424 and their application is described in more detail in RTCA documents DO-236B and DO-201A.*

Note.- *Numerical values for tracks must be automatically entered from the RNP system database.*

12) the capacity to show an indication of RNP failure, including the associated sensors, in the primary field of view of the pilot.

13) the capacity to advise the flight crew if the NSE alert limit (alert provided by the on board performance control and alert function) has been exceeded.

i) **Flight director/autopilot.-** It is recommended that the flight director (FD) and/or autopilot (AP) be kept coupled for RNP approaches. FD or AP coupling is mandatory when lateral TSE cannot be shown without these systems. In this case, operational procedures must indicate that FD and/or AP coupling from the RNP system is mandatory for RNP APCH procedures.

j) **Database integrity.-** Navigation database providers must comply with RTCA DO-200A. A letter of acceptance (LOA) issued by the appropriate regulatory authority to each one of the participants in the data chain demonstrates compliance with this requirement. Positive compliance with this requirement will be considered for those LOAs Type 2 issued prior to the publication of this AC.

9.4 System eligibility and approval of RNP APCH operations

a) **Introduction.-** The original equipment manufacturer (OEM) or holder of the aircraft installation approval (*e.g.,* the holder of the supplementary type certificate (STC)), must show the CAA that it complies with the appropriate provisions of this AC. The approval can be recorded in the documentation of the manufacturer (*e.g.,* service letters (SL), etc.). No entries in the AFM are required provided the CAA accepts manufacturer documentation.

b) **Eligibility for RNP instrument approach operations.-** Systems that meet the requirements of paragraph 9.2 of this AC are eligible for RNP instrument approach operations. The aircraft qualified in keeping with SRVSOP AC 91-009 or equivalent, *e.g.,* FAA AC 90-101 or EASA AMC 20-26 are considered qualified for RNP APCH operations without any additional trials.

c) **System eligibility for RNP approach operations**

1) **Qualification of the line of LNAV minima**

(a) **Autonomous systems.-** Autonomous systems that comply with TSO-C129/ETSO-C129 Class A1 or TSO-C146/ETSO-C146 Classes 1, 2, or 3 meet the aircraft qualification requirements for RNP instrument approach operations using a line of LNAV minima, provided the facilities for instrument flight rules (IFR) were established in keeping with AC 20-138. RNP systems must be approved based on AC 20-138 or equivalent.

(b) **Multi-sensor systems.-**

(1) Multi-sensor systems that use TSO-C129/ETSO-C129 sensors Classes B1, B3, C1, or C3 meet the qualification requirements for RNP APCH operations using a line of LNAV minima, provided:

- the facilities meet the criteria of this AC; and
- the associated flight management system (FMS) complies with TSO-C115b/ETSO-C115b and is installed in keeping with FAA AC 20-130.

(2) Multi-sensor systems that use TSO-C145/ETSO-C145 sensors Classes 1, 2, or 3 meet the aircraft qualification requirements for RNP instrument approach operations with a line of LNAV minima, provided:

- the facilities meet the criteria of this AC; and
- are installed in keeping with FAA AC 20-138.

2) **Qualification of the line of LNAV/VNAV minima**

(a) **Autonomous systems**

(1) TSO-C146/ETSO-C146 autonomous systems Classes 2 or 3 meet the aircraft qualification requirements for RNP APCH operations that use a line of LNAV/VNAV minima, provided the facilities meet at least the performance or functional requirements of this AC or equivalent.

(2) The systems that meet TSO-C129/ETSO-C129 can be used for RNP APCH operations using a line of LNAV/VNAV minima if they meet the criteria of this AC and AC 91-010 or equivalent.

(3) RNP systems must be approved in keeping with FAA AC 20-138 or equivalent, and systems using conventional baro-VNAV must provide a vertical navigation system performance that meets or exceeds the criteria of AC 91-010 or equivalent.

(b) **Multi-sensor systems.-**

(1) Multi-sensor systems that use TSO-C129/ETSO-C129 sensors Classes B1, B3, C1, or C3 or TSO-C145/ETSO-C145 sensors Classes 1, 2, or 3 meet the aircraft qualification requirements for RNP instrument flight operations using a line of LNAV/VNAV minima, provided the facilities meet the requirements of this AC and AC 91-010 or equivalent.

(2) RNP systems that use conventional baro-VNAV must provide a vertical navigation performance that meets or exceeds the criteria of AC 91-010 or equivalent.

(3) RNP systems must be installed in keeping with FAA AC 20-138 or equivalent and/or the associated FMS must comply with TSO-C115/ETSO-C115 and must be installed in keeping with AC 20-130 or equivalent.

9.5 Aircraft modification.-

a) If any system required for RNP APCH operations is modified (*e.g.,* changes in the software or hardware), the aircraft modification must be approved.

b) The operator must obtain a new operational approval that is supported by updated aircraft operational and qualification documentation.

10. OPERATIONAL APPROVAL

The airworthiness approval, by itself, does not authorise the operator to conduct RNP APCH operations. In addition to the airworthiness approval, the operator must obtain an operational approval confirming that the installation of the specific equipment is consistent with normal and contingency procedures.

10.1 Operational approval requirements.-

To obtain the RNP APCH authorisation, the operator will take the following steps, taking into account the criteria established in this paragraph and in paragraphs 10.2 to 10.10 of this AC.

a) *Airworthiness approval*.- aircraft shall have the corresponding airworthiness approvals as established in paragraph 9 of this AC.

b) *Application*.- The operator will submit the following documentation to the CAA:

1) *the RNP APCH operational approval application*;

2) *aircraft qualification documentation*.- Documentation showing that the equipment of the proposed aircraft meets the requirements of this AC, as described in paragraphs 9 and 10.3.

3) *Type of aircraft and description of the aircraft equipment to be used*.- The operator will provide a configuration list describing in detail the relevant components and the equipment to be used in the operation. The list shall include each manufacturer, model and version of the GPS equipment and the FMS software installed.

4) *Operational procedures and practices*.- Operator manuals shall properly indicate the navigation operating practices and procedures identified in paragraphs 10.4, 10.6, and 10.7 of this AC. LAR 91 operators shall confirm that they will operate using identified practices and procedures.

5) *Navigation data validation programme*.- Details of the navigation data validation programme are provided in Appendix 1 to this AC.

6) *Training programmes for the flight crew and flight dispatchers*.- According to paragraph 10.8 of this AC, operators must send their training syllabi and any other appropriate teaching material showing that operations have been included in their programmes. Training programmes must properly refer to the (navigation) operating practices and procedures identified in paragraphs 10.6 and 10.7 of this AC.

7) Instruction Program for maintenance personnel.- Operators will send instruction syllabus corresponding to maintenance personnel.

8) *Operations manual (OM) and checklists*.- Operators will submit the operations manuals and checklists containing information and guidance on RNP APCH operations.

9) *Maintenance procedures*.- The operator will submit the maintenance procedures containing airworthiness and maintenance instructions for the systems and equipment to be used in the operation. The operator will provide a procedure to remove and restore RNP APCH operational capability in the aircraft.

10) *Minimum equipment list (MEL)*.- The operator will submit any revision to the MEL needed to conduct operations.

c) *Training*.- Once the amendments to manuals, programmes and documents submitted have been accepted or approved, the operator will provide the necessary training to its personnel.

d) *Validation flights*.- The CAA may conduct validation flights if it deems it necessary for safety purposes. Validation flights will be conducted according to Chapter 13, Volume II, Part II of the SRVSOP Operation Inspector Manual (MIO).

e) *Issuance of the authorisation to conduct RNP APCH operations*.- Once the operator has successfully completed the operational approval process, the CAA will issue, as appropriate, the authorisation to the operator to conduct RNP APCH operations.

1) *LAR 91 operators*.- For operators LAR 91, the CAA will issue a letter of authorisation (LOA).

2) LAR 121 and/or 135 operators.- For LAR 121 and/or LAR 135 operators, the CAA will issue the corresponding operational specifications (OpSpecs) reflecting the RNP APCH authorisation.

10.2 Description of the aircraft equipment.-

c) The operator must establish and have available a configuration list detailing the components and equipment to be used for RNP APCH operations.

d) The list of required equipment shall be established during the operational approval process, taking into account the AFM. This list shall be used for updating the MEL for each type of aircraft that the operator intends to operate.

e) The details of the equipment and its use in keeping with the approach characteristics appear in this AC and in AC 91-010.

10.3 Aircraft qualification documentation.-

a) For aircraft currently conducting (GPS) RNAV or GPS approaches according to FAA AC 90-94 or equivalent.- No documentation is required for aircraft that have an AFM or AFM supplement that indicates that the aircraft is approved for flying (GPS) RNAV or GPS approaches, up to a line of LNAV minima.

b) For aircraft not approved for flying (GPS) RNAV or GPS instrument approach procedures.- Operators will submit to the CAA the RNP qualification documentation showing compliance with this AC, provided the equipment is properly installed and operated.

Note.- *Before requesting an RNP APCH authorisation, operators shall review all equipment performance requirements. Equipment installation by itself does not ensure operational approval nor authorises its operational use.*

10.4 RNP APCH operational documentation.-

a) The operator will develop RNP APCH operational documentation for using the equipment, based on the aircraft or avionics manufacturer documentation.

b) The operational documentation of the aircraft or avionics manufacturer will consist of recommended operating procedures and suggestions on training programmes for the flight crew, in order to help operators meet the requirements of this AC.

10.5 Acceptance of the documentation

a) **New aircraft/equipment (aircraft/equipment in the process of being manufactured or recently manufactured).-** The aircraft/equipment qualification documentation may be approved as part of the aircraft certification project and be reflected in the AFM and related documents.

b) **aircraft/equipment in service (capacity achieved in service).-** Prior approvals issued for conducting (GPS) RNAV or GPS instrument approaches according to AC 90-94 or equivalent do not require additional evaluations. For facilities/equipment not eligible to conduct (GPS) RNAV or GPS instrument approaches, the operator will submit aircraft or avionics qualification documentation to the CAA.

c) The relevant CAA organisation will review the RNP APCH application package. Acceptance will be documented by means of a letter to the operator.

10.6 Operational procedures

a) **Pre-flight planning.-**

1) Operators and pilots planning to conduct RNP APCH operations must insert the appropriate codes in the flight plan.

2) When initiating the system, pilots must make sure that the navigation database is valid and that it includes the appropriate procedures. Likewise, pilots must verify that the aircraft position is correct.

Note.- *Navigation databases are expected to be valid during the flight. If the AIRAC cycle is subject to changes during the flight, the operators and pilots shall establish procedures to ensure the precision of navigation data, including the capacity of navigation facilities to define routes and flight procedures. Traditionally, this has been done by comparing electronic data with printed documents. An acceptable method is to compare aeronautical charts (new and old) in order to verify navigation fixes before dispatch. If an amended letter for the procedure is published, the database must not be used for conducting the operation.*

3) Pilots must check the proper insertion of the assigned ATC route once they have received the initial authorisation and following any subsequent changes along the route. Likewise, pilots must make sure that the sequence of fixes shown on the navigation system coincides with the assigned route and with the route shown on the appropriate charts.

Note.- *Pilots may note a slight difference between the navigation information contained in the chart and the course shown on the primary navigation display. A difference of 3 degrees or less may be due to a magnetic variation applied by the equipment manufacturer and may be operationally acceptable.*

Note.- *Manual selection of functions that limit the aircraft bank angle may reduce its ability to maintain the desired track and is not advisable.*

4) The aircraft RNP capacity depends on the aircraft operational equipment. The flight crew must be capable of assessing the effect of an equipment failure on the foreseen RNP APCH operation and take appropriate action. When a flight dispatch is based on flying an RNP APCH procedure that requires the use of AP or FD at the destination or alternate aerodrome, the operator must verify that the AP and/or FD are installed and operational.

5) Flight crews must make sure that the approaches to be used in a foreseen operation can be selected from a valid navigation database (valid AIRAC cycle), that they have been verified through an appropriate process (navigation database integrity process), and that their use has not been prohibited by any NOTAM named by ACC or service provider or operational provision of the company.

6) Pilots must make sure that there are enough means to fly and land at the destination or alternate aerodrome in case of loss of RNP APCH capability.

7) Operators and flight crews must take into account any NOTAM named by AAC or service provider, or operational provision of the company that might adversely affect aircraft system operation or the availability or adequacy of the procedures at the destination or alternate aerodromes.

8) For missed approach procedures based on conventional NAVAIDs (VOR, NDB), pilots must check that the aircraft equipment required for such procedures is installed and operational. Likewise, they must check that ground NAVAIDs are operational.

9) The availability of the navigation infrastructure required for the selected routes and for RNP APCH operations (including any non-RNP contingency) must be confirmed for the time period of the selected operation, using all available information. Since GPS integrity (*e.g.,* the signal of the receiver autonomous integrity monitoring (RAIM) or of the satellite-based augmentation system (SBAS)) is required, the availability of such signals must be verified, as appropriate.

10) RAIM prediction must be done prior to departure.

(a) The prediction capability must take into account known and foreseen spaces without GPS satellite coverage, or other effects on navigation system sensors. The prediction programme should not use a masking angle of less than 5 degrees, since operational

experience shows that satellite signals are not reliable at low elevations. RAIM availability prediction should take into account the latest notices to airmen (NOTAMs) from the GPS constellation, named by AAC or service provider, and use an algorithm identical to the one used in the aircraft equipment, or an algorithm based on RAIM prediction assumptions providing a more conservative result. RAIM availability may be confirmed using a model-specific RAIM prediction.

(b) The available RAIM prediction software does not guarantee the service. The software is a tool for assessing the foreseen capacity to achieve the required navigation performance. Due to unexpected failures in some GPS elements, pilots must understand that RAIM or GPS navigation can fail in flight, and this might require reversal to an alternate means of navigation. Therefore, pilots must assess their ability to fly to an alternate aerodrome in case GPS navigation fails.

(c) In the event of continuous and predictable loss of RAIM for more than 5 minutes anywhere during the RNP APCH operation, the flight should be delayed, cancelled, or assigned another route in which RAIM requirements can be met.

11) For aircraft using SBAS receivers (all TSO-C145/C146/ ETSO-C145/C146 systems), operators shall take into account the latest NOTAMs from the GPS and SBAS constellation named by AAC or service provider. If the NOTAMs indicate that the SBAS signal is not available for the proposed flight route, the operators should check the proper availability of the RAIM GPS.

b) **Before starting the procedure.-**

1) Before starting the approach (prior to the initial approach fix (IAF)), in addition to normal procedures, the flight crew must check that the correct procedure has been loaded, by comparing said procedure with approach charts. This verification must include:

(a) the sequence of fixes;

(b) the integrity of tracks and distances of the approach segments, the precision of the course of entry, and the length of the final approach segment.

Note.- *As a minimum, this verification could be a simple inspection of a map display that permits the achievement of the objectives of this paragraph.*

2) The flight crew must also verify which are the fly-by and flyover waypoints, based on a published chart, a map display, or a control display unit (CDU).

3) For multi-sensor systems, the flight crew must verify, during the approach, that the GNSS sensor is used for estimating the position.

4) For an RNP system with an aircraft-based augmentation system (ABAS) that requires corrected barometric altitude, the valid aerodrome barometric altimeter must be set at the right time and location, according to flight operation performance.

5) When the operation is based on ABAS availability, the flight crew must check RAIM availability again if the estimated time of arrival (ETA) is more than 15 minutes different from the ETA used for flight planning. Likewise, this verification is automatically processed 2 NM before the FAF for a TSO-C129a/ ETSO-C129a Class A1 receiver.

6) In the terminal area, ATC tactical interventions may include radar headings, clearance to go “direct to”, which can avoid the initial approach segments, the intersect of an initial or intermediate approach segment, or the insertion of waypoints extracted from the navigation database. When following ATC instructions, the flight crew must be aware of RNP system limitations.

(a) Flight crews are not allowed to manually enter coordinates in the RNP system for operations within the terminal area.

(b) "Direct to" clearances may be accepted up to the intermediate fix (IF), provided the change in the track at the IF does not exceed 45º.

Note.- *A "direct to" clearance to the FAF is not acceptable.*

7) The lateral definition of the flight path between the FAF and the missed approach point (MAPt) under no circumstance must it be revised by the flight crew.

c) **During the procedure.-**

1) Pilots must follow the instructions or procedures identified by the operator, as necessary, to meet the performance requirements of this AC.

2) Before starting the descent, the aircraft must be established in the final approach course no further than the final approach fix **(**FAF) to ensure obstacle and terrain clearance.

3) Pilots must verify that the navigation system is in approach mode within 2 NM prior to the FAF.

Note.- *This verification does not apply to certain RNP systems (e.g., for aircraft that have been approved with a demonstrated RNP capacity). For such systems, other means are available, including electronic map display, flight guidance mode indications, etc., that clearly indicate the flight crew that the approach mode is activated.*

4) The appropriate displays must be selected in such a way that the following information can be monitored by the flight crew:

(a) the calculated desired RNP track (DTK) and

(b) the position of the aircraft relative to cross-track deviation (XTK) from the path for the flight technical error (FTE).

5) An RNP APCH procedure must be discontinued:

(a) if the navigation display is announcing a failure: or

(b) in case of loss of the integrity alert function; or

(c) if there is an annunciation that the integrity alert function is not available after crossing the FAF; or

(d) if the FTE is excessive.

6) A missed approach must be flown according to the published procedure. Use of an RNP system during the missed approach is acceptable, provided:

(a) the RNP system is operational (*e.g.,* there is no loss of function, NSE alert, and failure indication).

(b) the complete procedure (including the missed approach) is loaded from the navigation database.

7) During an RNP APCH procedure, pilots must use a lateral deviation indicator, FD and/or AP in the lateral navigation mode. Pilots of aircraft with lateral deviation indicator (*e.g*., CDI) must make sure that the scale of the lateral deviation indicator (maximum deflection) is consistent with the navigation precision associated with the different procedure segments (*e.g.,* ± 1.0 NM for the initial, intermediate, and missed approach segments, and ± 0.3 NM for the final approach segment).

8) Pilots are expected to maintain the procedure line during the RNP APCH procedure, as represented by the aircraft and/or flight guidance lateral deviation indicators, unless the ATC authorises a deviation or in emergency conditions.

9) For normal operations, the cross-track error/deviation (the difference between the calculated RNP system path and the position of the aircraft relative to the path) must be limited to ± ½ of the navigation precision associated to the procedure (*e.g.,* 0.5 NM for the initial and intermediate segments, 0.15 NM for the final approach segment, and 0.5 NM for the missed approach segment). Short deviations from this requirement are allowed (*e.g.,* overshooting and undershooting) during and immediately after the turn, up to a maximum of one time the navigation precision (*e.g.,* 1.0 NM for the initial and intermediate segments).

10) When using baro-VNAV for vertical path guidance during the final approach segment, deviations above or below the vertical path must not exceed + 100/-50 ft respectively.

11) The flight crew must start a missed approach if lateral or vertical deviations exceed the criterion of the previous paragraph, unless the required visual conditions exist between the aircraft and the foreseen landing runway to continue the approach.

12) For aircraft requiring two pilots, the flight crew must check that each pilot altimeter has the valid setting before starting the final approach of an RNP APCH procedure. The flight crew must also take note of any operational limitation associated with altimeter setting sources and latency in order to verify and set the altimeters when approaching the FAF.

13) Although the scale should change automatically, the pilots of an aircraft with lateral deviation indicator (*e.g.,* CDI) must make sure that the scale of the lateral deviation indicator (maximum deflection) is consistent with the different segments of the procedure (e.g., ± 1.0 NM for the initial, intermediate, and missed approach segments, and ± 0.3 NM for the final approach segment).

14) RNP APCH procedures require monitoring of lateral track deviations by the flight crew, and, if installed, monitoring of vertical track deviations in the pilot primary flight displays (PFD) to ensure that the aircraft stays within the defined boundaries of the procedure.

10.7 Contingency procedures

a) pilots must report any loss of RNP APCH capability and the proposed course of action to the ATC.

b) if the pilots cannot meet the requirements of an RNP APCH procedure, they must notify the air traffic service (ATS) as soon as possible.

c) the loss of RNP APCH capacity includes any failure or event that results in the aircraft not being able to meet the requirements of the RNP APCH procedure.

d) operators must develop contingency procedures to react safely to a loss of RNP APCH capacity during the approach.

e) in case of communication failure, the flight crew must continue with the RNP APCH procedure according to the published procedures for loss of communication.

f) the operator contingency procedures must refer to at least the following conditions:

1) Failure of RNP system components, including those affecting the lateral or vertical deviation performances (*e.g.,* failure of a GPS, FD, or AP sensor); and

2) Loss of the signal-in-space (loss or degradation of the outer signal).

g) the pilot must ensure the capacity to navigate and land at an alternate aerodrome in the event of loss of RNP APCH capacity.

10.8 Training programme

a) The training programme must provide sufficient training (*e.g.,* training in flight simulators, flight training devices, or on the aircraft) on aircraft RNP systems. The training programme will cover at least the following aspects:

1) information about this AC.

2) the meaning and proper use of RNP systems.

3) the characteristics of the procedures, as defined in chart displays and their written description.

4) representation of WPT types (fly-by and flyover waypoints), required path terminators (IF, TF, and DF), and any other type used by the operator, as well as associated aircraft flight paths.

5) navigation equipment required to conduct an RNP APCH operation (at least, a GNSS-based RNP system).

6) specific information on RNP systems:

   (a) automation levels, annunciation modes, changes, alerts, interactions, reversals, and degradation;

   (b) functional integration with other aircraft systems;

   (c) the meaning of route discontinuities, as well as related flight crew procedures;

   (d) monitoring procedures for each flight phase;

   (e) types of navigation sensors used by the RNP and associated systems;

   (f) turn anticipation, taking into account the effect of speed and altitude; and

   (g) interpretation of electronic displays and symbols.

7) the operating procedures for RNP equipment, where applicable, including how to conduct the following actions:

   (a) checking the validity of the aircraft database;

   (b) checking the successful completion of RNP system verification;

   (c) initialising the position of the RNP system;

   (d) retrieving and executing an RNP APCH procedure;

   (e) compliance with speed and/or altitude limitations associated to an approach procedure;

   (f) intercepting an initial or intermediate segment of an approach, following an air traffic control (ATC) notification;

   (g) verification of WPTs and programming of the operational flight plan;

   (h) direct flight to a WPT;

   (i) determining cross-track error/deviation;

   (j) entering and deleting a route discontinuity;

   (k) verifying the gross navigation error using conventional NAVAIDs; and

   (l) changing the destination and alternate aerodromes.

8) the automation levels recommended for the flight phase and workload, including methods to minimise cross-track error to maintain the procedure line.

9) radio communication phraseology for RNP applications.

10) ability to execute contingency procedures following RNP system failures.

10.9 Navigation Database

a) The operator must obtain the navigation databases from a qualified provider.

b) Navigation data providers must have a letter of acceptance (LOA) in order to process the navigation information (*e.g.,* FAA AC 20-153 or document on the conditions for the issuance of letters of acceptance for navigation data providers by the European Aviation Safety Agency – EASA (EASA IR 21 Sub-part G) or equivalent documents). An LOA recognises the data of a provider as those in which the quality, integrity, and quality management practices are consistent with the criteria of document DO-200A/ED-76. An operator provider (*e.g.,* an FMS company) must have an LOA Type 2 and its respective providers must have an LOA Type 1 or 2 AAC may accept a LOA submitted to navigation data providers or submit its own LOA.

c) The operator must report to the navigation data provider any discrepancy that invalidates a procedure, and disallow the use of the affected procedures by means of a notice to flight crews.

d) Operators should consider the need to conduct periodic verifications of navigation databases to ensure continued compliance with the existing requirements of the quality system or safety management system.

10.10 Follow-up of navigation error reports

a) The operator will establish a process to receive, analyse, and do the follow-up of navigation error reports that will help determine the appropriate corrective action.

b) Repetitive occurrences of navigation errors attributed to a specific part of the navigation equipment may result in the cancellation of the approval for using the equipment.

c) The information showing the potential for repetitive errors may require the modification of the training programme of the operator.

d) The information attributing multiple errors to a given pilot may require that additional training be given to the pilot or a revision of the license of the pilot.

APPENDIX 1

NAVIGATION DATA VALIDATION PROGRAMME

1. INTRODUCTION

The procedure stored in the navigation database defines the aircraft lateral and vertical guidance. The navigation database is updated every 28 days. The navigation data used in each update are critical for the integrity of each RNP APCH procedure. Bearing in mind the reduced obstacle clearance associated to these approaches, the validation of navigation data requires special consideration. This appendix provides guidance on the procedures to be followed by the operator to validate navigation data associated with RNP APCH procedures.

2. DATA PROCESSING

a) In its procedures, the operator will identify the person responsible for the navigation data updating process.

b) The operator must document a process for accepting, verifying, and loading navigation data into the aircraft.

c) The operator must place its process of documented data under configuration control.

3. INITIAL VALIDATION OF DATA

The operator must validate each RNP APCH procedure before flying the procedure under instrument flight meteorological conditions (IMC) to ensure compatibility with the aircraft and that the resulting paths correspond to the published procedure. As a minimum, the operator must:

a) compare the navigation data of the procedure to be loaded on the FMS with a published procedure.

b) validate the navigation data of the loaded procedure, either in the flight simulator or in the aircraft under visual flight meteorological conditions (VMC). The procedure outlined in a map display must be compared to the published procedure. The complete procedure must be flown to make sure that the path can be used, that it has no apparent lateral or vertical path disconnections, and is consistent with the published procedure.

c) once the procedure is validated, a copy of the validated navigation data must be kept and maintained to be compared with subsequent data updates.

4. DATA UPDATING

Whenever the operator receives a navigation data update and before using such data on the aircraft, the update must be compared with the validated procedure. This comparison must identify and resolve any discrepancy in the navigation data. If there are any significant changes (changes affecting the approach path or performance) to any part of the procedure, or if such changes are verified through initial information data, the operator must validate the amended procedure based on the initial validation of the data.

5. NAVIGATION DATA PROVIDERS

Navigation data providers must have a letter of acceptance (LOA) to process these data (*e.g.,* FAA AC 20-153 or document on the conditions for the issuance of letters of acceptance for navigation data providers by the European Aviation Safety Agency – EASA (EASA IR 21 Sub-part G) or equivalent document). An LOA recognises the data of a provider as those in which the quality, integrity, and quality management practices are consistent with the criteria of document DO-200A/ED-76. The operator provider (*e.g.*, an FMS company) must have an LOA Type 2 and its respective providers must have an

LOA Type 1 or 2. AAC may accept a LOA submitted to the navigation data providers or submit its own LOA.

6. AIRCRAFT MODIFICATIONS (DATA BASE UP TO DATE)

If an aircraft system required for RNP APCH operations is modified (*e.g.,* a change in the software), the operator is responsible for validating the RNP APCH procedures with the navigation database and the modified system. This can be done without direct assessment if the manufacturer verifies that the modification has no effect on the navigation database or on path calculation. If this verification is not done by the manufacturer, the operator must carry out an initial validation of the navigation data with the modified system.

APPENDIX 2

RNP APCH APPROVAL PROCESS

a) The RNP APCH approval process consists of two types of approvals: the airworthiness and the operational approval. Although the two have different requirements, they must be considered within a single process.

b) This process constitutes an orderly method used by the CAAs to ensure that applicants meet the established requirements.

c) The approval process consists of the following phases:

1)	Phase one:	Pre-application
2)	Phase two:	Formal application
3)	Phase three:	Review of the documentation
4)	Phase four:	Inspection and demonstration
5)	Phase five:	Approval

d) In *Phase one - Pre-application*, the CAA meets with the applicant or operator (pre-application meeting), who is advised of all the requirements it must meet during the approval process.

e) In *Phase two - Formal application*, the applicant or operator submits the formal application, accompanied by all the relevant documentation, as established in paragraph 10.1 of this AC.

f) In *Phase three - Review of documentation*, the CAA evaluates the documentation and the navigation system to determine their eligibility and the approval method to be applied with respect to the aircraft. As a result of this review and evaluation, the CAA may accept or reject the formal application together with the documentation.

g) In *Phase four - Inspection and demonstration*, the operator will train its personnel and conduct validation flights, if required.

h) In *Phase five - Approval*, the CAA issues the RNP APCH authorisation once the operator has met the airworthiness and operational requirements. For LAR 121 and 135 operators, the CAA will issue the OpSpecs, and for LAR 91 operators, it will issue an LOA.

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APPENDIX C

ADVISORY CIRCULAR

AC	**:**	**91-009**
DATE	**:**	**12/02/09**
REVISION	**:**	**Original**
ISSUED BY	**:**	**SRVSOP**

SUBJECT: APPROVAL OF AIRCRAFT AND OPERATORS FOR RNP APPROACH OPERATIONS REQUIRING AUTHORIZATION (RNP AR APCH)

1. PURPOSE

This advisory circular (AC) provides acceptable means of compliance (AMC) for the approval of aircraft and operators applying for RNP approach operations requiring authorization (RNP AR APCH).

An operator may use other means of compliance, provided they are acceptable for the civil aviation administration (CAA).

Use of the future tense of the verb or use of the term “must” applies to an applicant or operator that chooses to meet the criteria established in this AC.

2. RELATED SECTIONS OF THE LATIN AMERICAN AERONAUTICAL REGULATIONS (LARs) OR EQUIVALENT

LAR 91: Section 91.880 (b) or equivalent

LAR 121: Section 121.995 (b) or equivalent

LAR 135: Section 135.565 (c) or equivalent

3. RELATED DOCUMENTS

Annex 6	Aircraft Operations
Annex 10	Aeronautical Telecommunications
	Volume I: Radio Navigation Aids
Doc 9613	Performance-based Navigation Manual (PBN)
Doc 9905 (final draft)	Required Navigation Performance Authorization Required (RNP AR) Procedure Design Manual
Doc 8168	Aircraft Operations
	Volume I: Flight Procedures
	Volume II: Construction of Visual and Instrument Flight Procedures
AMC 20-6	Airworthiness Approval and Operational Criteria for RNP Authorization Required (RNPAR) Operations
FAA AC 90-101	Approval Guidance for RNP Procedures with SAAAR
IFFP/2 WP/5	Instrument flight procedure panel (IFPP) – PBN working group meeting - Working paper 5: Flight operational safety assessment (FOSA) prepared by Dave Nakamura.

4. DEFINITIONS AND ABBREVIATIONS

4.1 Definitions

a) **Authorization required (AR).-** Specific authorization required by the CAA for an operator to be able to conduct RNP approach operations that need mandatory authorization (RNP AR APCH).

b) **Primary field of view.-** For purposes of this AC, the primary field of view is within 15 degrees of the primary line of sight of the pilot.

c) **Navigation specifications**.- Set of aircraft and flight crew requirements to support performance-based navigation operations within a defined airspace. There are two classes of navigation specifications: RNAV and RNP. The RNAV specification does not include on-board performance control and alert requirements. The RNP specification includes on-board performance control and alert requirements.

d) **Estimated position uncertainty (EPU)**.- A measure in nautical miles (NM) based on a defined scale that indicates the estimated performance of the current position of the aircraft, also known as navigation performance (ANP) or estimated position error (EPE) in some aircraft. The EPU is not an estimate of the actual error, but a defined statistical indication.

e) **Performance-based navigation (PBN)**.- Performance-based area navigation requirements applicable to aircraft conducting operations on an ATS route, in an instrument approach procedure, or a designated airspace.

Performance requirements are expressed in the navigation specifications (RNAV and RNP specifications) in terms of the precision, integrity, continuity, availability, and functionality required for the intended operation within the context of a particular airspace concept.

f) **Area navigation (RNAV)**.- Navigation method that permits aircraft operations in any desired flight path within the coverage of ground-based or space-based navigation aids, or within the capability limits of autonomous aids, or through a combination of the two.

Area navigation includes performance-based navigation as well as other operations not contemplated in the performance-based navigation definition.

g) **Barometric vertical navigation (baro-VNAV).-** A function of some RNAV systems that displays an estimated vertical guide to the pilot, referred to as a specific vertical path. The estimated vertical guide is based on barometric altitude information and is commonly estimated as a geometric path between two waypoints or as an angle based on a single waypoint.

g) **RNP operations**.- Aircraft operations that use an RNP system for RNP applications.

h) **Required navigation performance (RNP)**.- Statement of the navigation performance required to operate in a defined airspace.

i) **Way-point (WPT).-** A specified geographical location used to define an area navigation route or the flight path of an aircraft employing area navigation. Way-points are identified as either:

Fly-by way-point.- A way-point that requires turn anticipation to allow tangential interception of the next segment of a route or procedure.

Flyover way-point.- A way-point at which a turn is initiated in order to join the next segment of a route or procedure.

k) **Initial approach fix (IAF).-** Fix that marks the beginning of the initial segment and the end of the arrival segment, if applicable. In RNAV application, this fix is normally defined as a “fly-by fix”.

j) **Flight management system (FMS)**.- Integrated system made up by an on-board sensor, a receiver, and a computer with navigation and aircraft performance databases, capable of providing performance values and RNAV guidance to a display and automatic flight control system.

k) **Global positioning system (GPS)**.- The U.S. global navigation satellite system (GNSS) is a satellite-based radio navigation system that uses precise distance measurements to determine the position, speed and time anywhere in the world. The GPS is made up by the spatial, control and user elements. The spatial element is made up by at least 24 satellites in 6 orbiting planes. The control element consists of 5 monitoring stations, 3 ground antennas, and one main control station. The user element consists of antennas and receivers that provide the user with position, speed, and precise time information.

l) **Global navigation satellite system (GNSS)**.- Generic term used by ICAO to define any global positioning and timing system made up by one or more main satellite constellations, such as the GPS and the global navigation satellite system (GLONASS), aircraft receivers, and several integrity surveillance systems, including aircraft-based augmentation systems (ABAS), satellite-based augmentation systems (SBAS), such as the wide-area augmentation system (WAAS) and ground-based augmentation systems (GBAS), such as the local-area augmentation system (LAAS).

Distance information will be provided, at least in the immediate future, by GPS and GLONASS.

m) **RNP system**.- Area navigation system that provides on-board performance control and alert.

n) **RNP value**.- The RNP value designates the lateral performance requirement associated with a procedure. Examples of RNP values are: RNP 0.3 and RNP 0.15.

o) **Receiver autonomous integrity monitoring (RAIM)**.- Technique used in a GPS receiver/processor to determine the integrity of its navigation signals, using only GPS signals or enhanced GPS signals with barometric altitude data. This determination is achieved by a consistency check between redundant pseudo-range measurements. At least one satellite in addition to those required must be available to obtain the navigation solution.

p) **Radius to fix (RF) leg.-** An RF leg is defined as any circular path (an arc) with a constant radius around a defined turn centre that starts and ends in a fix.

4.2 Abbreviations

a)	CAA	Civil aviation administration
b)	ABAS	Aircraft-based augmentation system
c)	AGL	Above ground level
d)	AP	Automatic pilot
e)	APCH	Approach
f)	APQ	Advance qualification program
g)	APV	Approach procedure with vertical guide
h)	AR	Authorization required
i)	AIP	Aeronautical information publication
j)	AIRAC	Aeronautical information regulation and control
k)	AC	Advisory circular (FAA)
l)	AFM	Aircraft flight manual
m)	AIM	Aeronautical information manual
n)	AMC	Acceptable means of compliance
o)	ANP	Navigation performance
p)	ANSP	Air navigation service provider
q)	ATC	Air traffic control

r)	ATS	Air traffic service
s)	baro-VNAV	Barometric vertical navigation
t)	AC	Advisory circular (SRVSOP)
u)	CDI	Course deviation indicator
v)	CDU	Control display unit
w)	CF	Course to a fix
x)	DA/H	Decision altitude/height
y)	DF	Direct to a fix
z)	DME	Distance-measuring equipment
aa)	EASA	European Aviation Safety Agency
bb)	EGPWS	Enhanced ground proximity warning system
cc)	EPE	Estimated position error
dd)	EPU	Estimated position uncertainty
ee)	EUROCAE	European Organization for Civil Aviation Equipage
ff)	FA	Course from a fix to an altitude
gg)	FAA	United States Federal Aviation Administration
hh)	FAF	Final approach fix
ii)	FD	Flight director
jj)	FMS	Flight management system
kk)	FOSA	Flight operational safety assessment
ll)	FSD	Maximum deflection
mm)	FTD	Flight training devices
nn)	FTE	Flight technical error
oo)	GBAS	Ground-based augmentation system
pp)	GNSS	Global navigation satellite system
qq)	GLONASS	Global navigation satellite system
rr)	GP	Glide path
ss)	GPS	Global positioning system
tt)	GS	Ground speed
uu)	HAL	Horizontal alert limit
vv)	HIL	Horizontal integrity limit
ww)	HPL	Horizontal protection level
xx)	IAC	Instrument approach chart
yy)	IAF	Initial approach fix
zz)	IFR	Instrument flight rules
aaa)	INS	Inertial navigation system
bbb)	ILS	Instrument landing system

ccc)	IRS	Inertial reference system
ddd)	IRU	Inertial reference unit
eee)	ISA	International standard atmosphere
fff)	LAAS	Local area augmentation system
ggg)	LAR	Latin American Aeronautical Regulations
hhh)	LNAV	Lateral navigation
iii)	LOA	Letter of authorization
jjj)	LOE	Line-oriented evaluation
kkk)	LOFT	Line-oriented flight training
lll)	MEL	Minimum equipment list
mmm)	NAVAIDS	Navigation aids
nnn)	NOTAM	Notice to airmen
ooo)	OACI	International Civil Aviation Organization
ppp)	OEM	Original equipment manufacturer
qqq)	OM	Operations Manual
rrr)	PBN	Performance-based navigation
sss)	PC	Proficiency check
ttt)	PDE	Path definition error
uuu)	PF	Pilot flying the aircraft
vvv)	POH	Pilot operations manual
www)	POI	Principal operations inspector
xxx)	PM	Pilot monitoring the aircraft
yyy)	PT	Proficiency training
zzz)	RA	Radio altimeter
aaaa)	RAIM	Receiver autonomous integrity monitoring
bbbb)	RF	Constant radius to fix arc
cccc)	RF leg	Constant radius to fix arc leg
dddd)	RF turn	Constant radius to fix turn
eeee)	RNAV	Area navigation
ffff)	RNP	Required navigation performance
gggg)	RNP APCH	Required navigation performance approach
hhhh)	RNP AR APCH	Required navigation performance authorization required approach
iiii)	RTCA	Requirements and technical concepts for aviation
jjjj)	SBAS	Satellite-based augmentation system
kkkk)	SET	Selected event training
llll)	SPOT	Special-purpose operational training
mmmm)	TF	Track to a fix

nnnn)	TLS	Target level of safety
oooo)	TOGA	Take-Off/Go-Around
pppp)	VDI	Vertical deviation indicator
qqqq)	VNAV	Vertical navigation
rrrr)	VOR	VHF omnidirectional radio range
ssss)	VPA	Vertical path angle
tttt)	WAAS	Wide area augmentation system

5. INTRODUCTION

5.1 ICAO Document 9613 - Manual on Required Navigation Performance (PBN), currently establishes two types of RNP navigation specifications for approach operations: RNP approach (RNP APCH) and RNP approach with authorization required (RNP AR APCH).

5.2 RNP AR APCH operations permit a high level of navigation performance and require that the operator meet additional aircraft and flight crew requirements in order to obtain an operational authorization from the CAA.

5.3 These operations can offer significant operational and safety advantages compared to other RNAV procedures, since they introduce additional navigation capabilities in terms of precision, integrity and functions allowing for operations with reduced obstacle clearance allowances that permit approach and departure procedures under circumstances in which other approach and departure procedures are neither possible nor satisfactory from the operational point of view.

5.4 RNP AR APCH operations include particular capabilities that require a special and mandatory authorization similar to that for ILS CAT II and CAT III operations.

5.5 All RNP AR APCH operations have reduced lateral obstacle evaluation areas and vertical obstacle clearance surfaces, based on aircraft and crew performance requirements stated in this AC.

5.6 RNP AR APCH operations are classified as vertical guide approach procedures (APV) according to Annex 6. In addition to lateral guide, this type of operation requires a positive vertical navigation guidance system for the final approach segment.

5.7 An RNP AR APCH procedure is designed when a direct approach is not operationally possible.

5.8 There are three features in procedure design criteria that must only be used when there is a specific operational need or a benefit. Accordingly, an operator may be authorized to any or all of the following sub-sets of these types of procedures:

- ✓ ability to fly a published arc, also referred to as a *radius to fix leg (RF leg)*
- ✓ *reduced obstacle evaluation area on the missed approach, also referred to as a missed approach requiring RNP less than 1.0*
- ✓ *an RNP AR APCH that employs a line of minima less than RNP 0.3 and/or a missed approach requiring an RNP less than 1.0*

5.9 An operator conducting an RNP AR APCH operation using a line of minima less than RNP 0.3 and/or a missed approach that requires an RNP less than 1.0 shall comply with paragraphs 5 and/or 6 of Appendix 2 to this AC.

5.10 The criteria in this AC are based on the use of multi-sensor navigation systems and barometric vertical navigation (baro-VNAV) systems.

5.11 According to ICAO Doc 9613, navigation precision associated with flight phases of RNP AR APCH approach are the following:

a) Initial segment: RNP 1.0 to 0.1

b) Middle segment: RNP 1.0 to 0.1

c) Final segment: RNP 0.3 to 0.1

d) Unsuccessful approach segment: RNP 1.0 to 0.1

5.12 Procedures RNP AR APCH are named as $RNAV_{(RNP)}$. Through Aeronautical Information Publication (AIP) and aeronautical letters will be specified permitted sensors or required RNP value.

5.13 The procedures to be implemented pursuant to this AC will permit the use of high-quality lateral and vertical navigation capabilities to improve safety and reduce the risks of controlled flight into terrain (CFIT).

5.14 The material described in this AC has been developed based on the following documents:

- ✓ Chapter 6, Volume II, Part C of ICAO Doc 9613 – RNP AR APCH Implementation; and
- ✓ Working Paper IFPP/2 WP/5 – Flight operational safety assessment (FOSA) submitted to the ICAO PBN Working Group meeting (22 September to 3 October 2008).

5.15 To the extent possible, this AC has been harmonized with:

- ✓ AMC 20-26 - Airworthiness approval and operational criteria for RNP authorization required (RNP AR) operations of the European Aviation Safety Agency (EASA); and
- ✓ AC 90-101 – Approval guidance for RNP procedures with SAAR, of the United States Federal Aviation Administration (FAA), published on 15 December 2005.

Note.- *Notwithstanding harmonization efforts, operators shall note the differences between this AC and the aforementioned documents when requesting an authorization from the corresponding Administrations.*

6. DESCRIPTION OF THE NAVIGATION SYSTEM

6.1 Lateral Navigation (LNAV)

a) In LNAV, RNP equipment enables the aircraft to navigate in accordance with appropriate routing instructions along a path defined by waypoints maintained in an on-board navigation database.

Note.- *Normally, LNAV is a mode of flight guidance systems where the RNP equipment provides path steering commands to the flight guidance system that controls flight technical error (FTE) through either manual pilot control with a path deviation display or through FD or AP coupling.*

b) For purposes of this AC, RNP AR APCH operations are based on the use of RNP equipment that automatically determines aircraft position on the horizontal plane using data inputs from the following types of position sensors (listed in no specific order of priority or combination), but whose primary basis for positioning is the GNSS.

1) Global navigation satellite system (GNSS).

2) Inertial navigation system (INS) or inertial reference system (IRS), with automatic position updating from suitable radio-based navigation equipment.

3) Distance measuring equipment (DME) that provides measurements from two or more ground stations (DME/DME)

Note.- *Depending on DME infrastructure, an operator may use DME/DME position updating as a means of reversal. This function must be assessed on a case-by-case basis and approved at the operational level.*

6.2 Vertical Navigation (VNAV)

a) In VNAV, the system enables the aircraft to fly level and descend relative to a linear, point-to-point vertical path that is maintained in an on-board navigation database. The vertical profile will be based on altitude constraints or vertical path angles (VPA) where appropriate, associated with the vertical

navigation path waypoints.

Note.- *Normally, VNAV is a mode of flight guidance systems, where RNP equipment with VNAV capability provides path steering commands to the flight guidance system that controls the flight technical error (FTE) through either manual pilot control with vertical deviation display or through FD or AP coupling.*

7. AIRCRAFT EQUIPMENT REQUIREMENTS

7.1 The operator must establish and have a configuration list available describing in detail the components and equipment to be used for RNP AR APCH operations.

7.2 The required equipment list shall be established during the operational approval process, taking into account the AFM and available operational mitigation methods. This list shall be used to update the MEL of each type of aircraft for which the operator submits an operational application.

7.3 The details of the equipment and its use in keeping with the characteristic(s) of each approach are described in the appendices to this AC.

8. AIRWORTHINESS AND OPERATIONAL APPROVAL

8.1 In order to get an RNP AR APCH authorization, a commercial air transport operator shall obtain two types of approval:

a) an airworthiness approval from the State of Registry; (see Article 31 of the Chicago Convention and paragraphs 5.2.3 and 8.1.1 of Annex 6, Part I); and

b) an operational approval from the State of the Operator (see paragraph 4.2.1 and Attachment F to Annex 6, Part I).

For general aviation operators, the State of Registry (See paragraph 2.5.2.2 of Annex 6 Part II) will determine if the aircraft meets the applicable RNP AR APCH requirements and will issue the operational authorization (*e.g.,* a letter of authorization – LOA).

8.2 An operator that has obtained operational approval can conduct RNP AR APCH operations in the same way as an operator that has been authorized to conduct ILS CAT II and III operations.

8.3 Before submitting the application, manufacturers and operators shall review all the performance requirements. Compliance with airworthiness requirements or the installation of the equipment, by itself, does not constitute operational approval.

8.4 Appendix 1 to this AC contains the RNP AR APCH procedure characteristics that must be taken into account by operators when conducting this type of operations.

8.5 In order to get operational approval, operators shall meet the requirements contained in Appendices 2 to 6 to this AC.

8.6 Appendix 7 contains a summarized list of requirements to obtain RNP AR APCH authorization, including the documents to be included in the application.

8.7 Appendix 8 contains a summarized guide on the approval process to get an RNP AR APCH authorization.

8.8 Appendix 9 provides guidance on the flight operational safety assessment (FOSA).

9. AIRWORTHINESS APPROVAL

9.1 Aircraft Qualification Documentation

a) Bearing in mind the particular requirements of RNP AR APCH operations and the need to develop aircraft- and navigation system-specific procedures for the flight crew, the operators shall submit the aircraft qualification documentation that complies with Appendix 2 to this AC. This documentation shall identify optional capabilities (*e.g.,* RF legs and RNP missed approaches), the RNP capability of each aircraft configuration, and the characteristics that can alleviate the need for operational

mitigation. This documentation shall define the procedures recommended for RNP aircraft maintenance.

9.2 Aircraft Acceptability

a) *For new aircraft*.- Aircraft qualification documentation can be approved by the CAA as part of an aircraft certification project, and will be reflected in the AFM and related documents.

b) *For aircraft in service*.- The operator shall send the aircraft certification to the corresponding CAA bodies (*e.g.*, aircraft certification division, or airworthiness inspection division, or equivalent). These bodies shall accept, as appropriate, the data package for RNP AR APCH operations. This acceptance will be documented in a letter addressed to the operator.

9.3 Aircraft Modification

a) In case a system required for RNP AR APCH operations is modified the aircraft modification must be approved.

b) The operator must obtain a new operational approval supported by the manufacturer updated aircraft operational and qualification documentation.

10. OPERATIONAL APPROVAL

10.1 In order to obtain RNP AR APCH authorization, the operator must meet the criteria set forth in this paragraph and in Appendix 7 - Requirements to obtain RNP AR APCH authorization.

10.2 RNP AR APCH Operational Documentation

a) The operator will submit operational documentation for RNP AR APCH operations in keeping with the following appendices to this AC: Appendix 3 – Navigation data validation program; Appendix 4 – Operational considerations; Appendix 5 – Training programs; and Appendix 6 – RNP monitoring programs.

b) *For new aircraft*.- The RNP AR APCH operational documentation submitted by the operator will be accepted by the relevant CAA body (for example, the aircraft certification division or flight standard body or equivalent).

c) *For aircraft in service*.- The operator shall send the RNP AR APCH operational documentation to the corresponding CAA bodies (for example, the aircraft certification division or flight standard body or equivalent). These entities will accept, as appropriate, the RNP AR APCH operational documentation. This acceptance will be documented in a letter addressed to the aircraft operator.

10.3 Operator Approval

a) LAR 91, 121, and 135 operators shall submit to the flight standard body or equivalent evidence of compliance with the aircraft operational or qualification documentation accepted by the CAA as described in Annex 7 to this AC. This documentation will indicate compliance with Appendices 2 to 9 and will be specific to aircraft equipment and procedures. Once the operator has met the requirements of this AC or equivalent, the CAA will issue the operational specifications (OpSpecs) for LAR 121 or 135 operators or a letter of authorization (LOA) for LAR 91 operators, authorizing RNP AR APCH operations.

b) **Provisional Authorization**

1) The operator will be authorized to conduct RNP AR APCH operations using RNP 0.3 minima during the first 90 days of operation or the period stipulated by the CAA, and at least during the first 100 approaches in each type of aircraft.

2) For approaches without a line of minima associated with RNP 0.3 (minima under 0.3), the procedure shall be conducted under visual meteorological conditions (VMC).

3) The provisional authorization will be withdrawn once the operator has completed the applicable period of time and the required number of approaches and once the CAA has reviewed the RNP AR APCH monitoring program reports.

Note 1.- *Operators with experience in equivalent RNP AR APCH operations may receive credit to reduce provisional authorization requirements.*

Note 2.- *Operators with experience in RNP AR APCH operations that are applying for new or modified system or aircraft operations, variations of the aircraft type or different aircraft types with identical crew procedures and interface may use reduced periods or approaches in the provisional authorization (for example, periods of less than 90 days and approaches of less than 50), as determined by the CAA.*

***Note 3.**- In particular circumstances in which compliance with 50 successful approaches could take a long time due to factors such as the small number of aircraft in the fleet, limited opportunities to use aerodromes with the appropriate procedures, and when an equivalent level of reliability can be obtained, consideration can be given, on a case-by-case basis, to a reduction in the required number of approaches.*

c) **Final Authorization**

1) The CAA will issue the OpSpecs or the LOA authorizing the use of the lowest applicable minima once the operators have successfully completed the time period and the number of approaches required by the CAA, as established in paragraph b) above.

APPENDIX 1

RNP AR APCH INSTRUMENT APPROACH PROCEDURES

1. INTRODUCTION

a) ICAO Doc 9905 - *Manual for the design of RNP procedures with authorization required (RNP AR)*, provides RNP AR APCH procedure design criteria.

b) This appendix provides a summary of the key characteristics of approach procedures, and introduces the types of RNP approach operations.

2. PARTICULAR CHARACTERISTICS OF RNP AR APCH APPROACHES

a) **RNP value**.- Each line of minima published has an associated RNP value; for example, RNP 0.3 or RNP 0.15. A minimum RNP value is documented as part of an RNP AR APCH authorization for each operator, and it may vary depending on aircraft configuration or operational procedures (for example, inoperative GPS, use of FD with or without AP).

b) **Procedures that include *radius to fix legs* (RF legs)**.- Some RNP procedures have curved paths, known as *radius to fix legs (RF legs).* Since not all aircraft can fly this type of legs, pilots are responsible for knowing if they can conduct an RNP AR APCH procedure with an RF leg. RNP requirements for RF legs will be indicated in the note section of instrument approach charts (IAC) or in the applicable initial approach fix (IAF).

c) **Missed approaches that require RNP values of less than 1.0**.- In designated locations, the airspace or the obstacle area will require an RNP capability of less than 1.0 during a missed approach from any location in the procedure. Navigation system reliability must be very high in these locations. These approaches will normally require redundant equipment since no single point-of-failure can cause a loss of RNP capability.

d) **Non-standard speeds or climb gradients**.- RNP AR APCH procedures are developed on the basis of standard approach speeds and a with climb gradient of 200 ft/NM in the missed approach. Any exception to these standards will be stated in the approach procedure and the operator will ensure compliance with any published limitation before conducting the operation.

e) **Temperature limits**.-

1) High and low temperature limits are identified in RNP AR APCH procedures for aircraft using barometric vertical navigation (baro-VNAV) without temperature compensation on the approach.

2) Aircraft using baro-VNAV with temperature compensation, or an alternate means of vertical guidance (*e.g.,* SBAS) can ignore temperature restrictions.

3) Since temperature limits established in the charts are assessed only for obstacle clearance in the final approach segment, and taking into account that temperature compensation affects only vertical guidance, the pilot may need to adjust the minimum altitude in the initial and intermediate approach segments and in the decision altitude/height (DA/H)).

Note 1.- *Temperature affects the indicated altitude. The effect is similar to having high and low pressure changes, but not as significant as those changes. When the temperature is higher than the standard (ISA), the aircraft will be flying above the indicated altitude. When the temperature is lower than the standard, the aircraft will be flying below the altitude indicated in the altimeter. For further information, refer to altimeter errors in the aeronautical information manual (AIM).*

Note 2.- *Pilots are responsible for all low (cold) temperature corrections required at all minimum altitudes/heights published. This includes:*

- the altitudes/heights for the initial and intermediate segments;
- the DA/H; and

- the subsequent missed approach altitudes/heights.

Note 2.- *The final approach path VPA is protected against the effects of low temperatures by the procedure design.*

f) **Aircraft size**.- The minima to be obtained may depend on the size of the aircraft. Large aircraft may require higher minima due to the height of the landing gear and/or aircraft wingspan. When appropriate, aircraft size restrictions will be reflected in RNP AR APCH procedure charts.

APPENDIX 2

AIRCRAFT QUALIFICATION

1. INTRODUCTION

a) This appendix describes aircraft performance and the functional criteria for qualifying an aircraft for RNP AR APCH operations.

b) Applicants may establish compliance with this appendix based on the type certification or supplementary type certification, and document said compliance in the AFM (supplement).

c) The operator of a previously certified aircraft may document compliance with this aircraft certification criterion without a new airworthiness project (for example, without a change in the AFM) and must report to the aircraft certification division or equivalent any new performance not covered by the original airworthiness approval.

d) The AFM or other proof of aircraft qualification shall indicate the normal and non-normal flight crew procedures, responses to failure alerts, and any other limitation, including information on the operation modes required for flying an RNP AR APCH procedure.

e) In addition to the specific RNP AR APCH guide presented in this AC, the aircraft must comply with AC 20-129 – Airworthiness approval of vertical navigation (VNAV) systems for use in the U.S. National Airspace System (NAS) and Alaska and either with AC 20-130 () – Airworthiness approval of navigation or flight management systems integrating multiple navigation sensors or AC 20-138 () – Airworthiness approval of NAVSTAR Global Positioning System (GPS) for use as a VFR and IFR supplemental navigation system, or equivalent documents.

2. PERFORMANCE REQUIREMENTS

This paragraph defines the general performance requirements for aircraft qualification. Paragraphs 3, 4, and 5 of this appendix provide guidance material on acceptable methods of compliance to meet such requirements.

a) **Path definition.-** Aircraft performance is assessed around the path defined by the published procedure and by Section 3.2 of document RTCA/DO.236B. All flight paths used in conjunction with the final approach segment will be defined by the flight path angle (VPA) (RTCA/DO-236B, Section 3.2.8.4.3) as a straight line to a fix and altitude.

b) **Lateral precision.-** Any aircraft conducting RNP AR APCH procedures must have a cross-track navigation error not greater than the precision value (0.1 NM to 0.3 NM) applicable to 95% of the flight time. This error includes the position error, the flight technical error (PTE), and the display system error. Likewise, the along-path position error must not be greater than the precision value applicable to 95 % of the flight time.

c) **Vertical precision.-** The vertical system error includes the altimeter error (assuming international standard atmosphere (ISA) temperature and lapse rates), the along-path effect of the error, the system calculation error, and the flight technical error. 99.7% of the system error in the vertical direction must not be less than (in feet):

$$\sqrt{((6076115)(1.225)\mathbf{RNP}\cdot tan\boldsymbol{\theta})^2+(60\,tan\boldsymbol{\theta})^2+75^2+\left(\left(-8.8\cdot10^{-8}\right)(\mathbf{h}+\boldsymbol{\Delta}\mathbf{h})^2+\left(6.5\cdot10^{-3}\right)(\mathbf{h}+\boldsymbol{\Delta}\mathbf{h})+50\right)^2}$$

Where θ is the vertical navigation path angle, h is the height of the local altimeter reporting station, and Δh is the height of the aircraft over the reporting station.

d) **Airspace containment.-** RNP AR APCH approaches are published as performance-based approaches; therefore, they do not require any specific procedure or technology, but rather a performance level.

1) **RNP and baro-VNAV aircraft.-** This AC provides acceptable methods of compliance for aircraft using an RNP system based mainly on GNSS, and a vertical navigation system (VNAV) based on a barometric altimeter. Paragraphs 3, 4, and 5 of this appendix, together with the guide established in Appendices 3 and 4, describe an acceptable method of acceptance to obtain the required navigation performance. Aircraft and procedures that comply with these paragraphs and appendices meet the airspace containment requirement.

2) **Other alternate systems or methods of compliance.-** For other alternate systems or methods of compliance, the likelihood of the aircraft exceeding the lateral and vertical limits of the obstacle clearance volume must not exceed 10^{-7} per approach (Doc 9905 - *Manual for the design of navigation required performance procedures with authorization required (RNP AR)*, including approach and missed approach. This requirement can be met through a safety assessment, applying:

- ✓ appropriate quantitative numerical methods;
- ✓ operational and procedural qualitative considerations and mitigations; or
- ✓ an appropriate combination of both quantitative and qualitative methods.

Note 1.- *This requirement applies to the total likelihood of excursions outside of the obstacle clearance volume, including events caused by latent conditions (integrity) and detected conditions (continuity) if the aircraft does not remain within the obstacle clearance volume after the failure is announced. The alert control limit, the latent status of the alert, the crew response time, and the aircraft response shall be taken into account when ensuring that the aircraft will not go outside the obstacle clearance volume. The requirement applies to a single procedure, considering the exposure time of the operation, the radio aid (NAVAID) geometry, and the navigation performance available for each published approach.*

Note 2.*- This containment requirement is derived from the operational requirement and is particularly different from the requirement specified in Document RTCA/DO-236B. The requirement in Document RTCA/DO-236B was developed to expedite airspace design and is not directly equivalent to obstacle clearance.*

e) **System control.-** A critical component of RNP during approach is the capability of the aircraft navigation system to control the navigation performance obtained and identify for the flight crew whether or not the operational requirement is being met during the operation.

3. GENERAL RNP AR APCH REQUIREMENTS

a) **Navigation Sensors.-** This section identifies the particular features of navigation sensors within the context of RNP AR APCH operations.

1) **Global Positioning System (GPS).-**

(a) The sensor must meet the criteria of FAA AC 20-138 (). For systems that comply with this AC, the following sensor precisions can be used in the total system precision analysis without any additional justification:

(1) GPS sensor precision better than 36 m (95%); and

(2) augmented GPS (GBAS or SBAS) sensor precision better than 2 m (95%).

(b) In case of latent failure of the GPS satellite and marginal geometry of said satellite (*e.g.,* horizontal integrity limit (HIL) equal to the horizontal alert limit (HAL)), the likelihood of the aircraft remaining within the obstacle clearance volume used to assess the procedure must be greater than 95% (both laterally and vertically).

Note.- *GNSS-based sensors produce an HIL, also known as horizontal protection level (HPL) (see AC 20-138A, Appendix 1 and document RTCA/DO-229C for an explanation of these terms). The HIL is a measure of the estimated position error, assuming a latent failure is present. Instead of a detailed analysis of the effects of latent failures on the total system error, an acceptable means of compliance for GNSS-based systems is to ensure the HIL remains twice as low as the navigation precision, minus 95% of the flight technical error (FTE), during RNP AR APCH operations.*

2) **Inertial reference system (IRS).-** An IRS must meet the criteria of LAR 121 Appendix G or US 14 CFR Part 121 Appendix G or equivalent. While Appendix G defines the 2-NM-per-hour drift rate (95%) requirement for flights up to 10 hours, this rate may not apply to an RNP system after loss of position updating. It is assumed that systems that have demonstrated compliance with LAR 121 Appendix G have an initial drift rate of 8 NM/hour for the first 30 minutes (95%), without further substantiation. Aircraft manufacturers and applicants can demonstrate improved inertial performance in accordance with the methods described in Appendix 1 or 2 of FAA Order 8400.12A.

Note.- *Integrated GPS/INS position solutions reduce the rate of degradation after loss of position updating. For coupled GPS/IRUs, RTCA/DO-229C Appendix R provides additional guidance.*

3) **Distance measuring equipment (DME).-** Initiation of all RNP AR APCH procedures is based on GNSS updating. Except where the use of DME in a procedure is specifically designated as “not authorized”, DME/DME updating can be used as a reversal mode during the approach and missed approach when the system complies with the navigation precision. The manufacturer and the operator shall identify any DME infrastructure or procedure limitation preventing an aircraft type from meeting this requirement.

4) **VHF omnidirectional radio range (VOR).-** For initial RNP AR APCH implementation, the RNP system may not use VOR updating. The manufacturer and the operator shall identify any VOR infrastructure or procedure limitation preventing a given aircraft type from meeting this requirement.

Note.- *This requirement does not imply that an equipment capability must exist providing a direct means of inhibiting VOR updating. A procedure that allows the flight crew to inhibit VOR updating or to execute a missed approach if the system reverts to VOR updating may meet this requirement.*

5) **Multi-sensor systems**.- For multi-sensor systems, there must be automatic reversal to an alternate RNAV sensor if the primary RNAV sensor fails. Automatic reversal from one multi-sensor system to another multi-sensor system is not required.

6) **Altimetry system error**.- 99.7% of the altimetry system error for each aircraft (assuming international standard atmosphere temperature and lapse rate) must be less or equal to the following, with the aircraft in the approach configuration:

$$\mathbf{ASE} = -8.8 \cdot 10^{-8} \cdot \mathbf{H}^2 + 6.5 \cdot 10^{-3} \cdot \mathbf{H} + 50$$

Where H is the true altitude of the aircraft.

7) **Temperature compensation systems.-** Systems that provide temperature-based corrections to the barometric VNAV guidance must comply with RTCA/DO-236 Appendix H.2. This applies to the final approach segment. Compliance with this requirement shall be documented to enable the operator to conduct RNP AR APCH approaches when the actual temperature is above or below the published procedure design limit. Appendix H.2 also provides guidance on operational aspects related to temperature compensation systems, such as intercepting compensated paths from non-compensated procedure altitudes.

b) **Flight path definition and flight planning**.-

1) **Track-keeping and transition legs.-** The aircraft must be capable of executing transition legs and maintain tracks consistent with the following paths:

(a) a geodetic line between two fixes;

(b) a direct to fix path;

(c) a specific track to a fix, defined by a course; and

(d) a specific track to an altitude.

Note 1.- *The standards for these paths may be found in documents EUROCAE ED-75 / RTCA DO-236B and in ARINC Specification 424 – Navigation database. These standards refer to these paths as path terminators: Track to a fix (TF), Direct to a fix (DF), Course to a fix (CF), Course from a fix to an altitude (FA). Likewise, some procedures require radius to a fix (RF) legs as described in paragraph 4 of this appendix. Documents EUROCAE ED-75A/RTCA DO-236B and ED-77/DO-201A describe in more detail the application of these paths.*

Note 2.- *Navigation systems can accommodate other ARINC 424 path terminators (e.g., heading to a manual terminator (VM)). Missed approach procedures may use these types of paths when there is no requirement for RNP containment.*

2) **Fly-By and Flyover Fixes**.- The aircraft navigation system must be capable of executing fly-by and flyover fixes. For fly-by turns, the navigation system must limit the path definition within the theoretical transition area defined in document EUROCAE ED-75B/RTCA DO-236B under the wind conditions identified in ICAO Doc 9905. The flyover turn is not compatible with RNP flight tracks and will only be used when there is no repetitive path requirement.

3) **Waypoint resolution error**.- The navigation database must provide sufficient data resolution to ensure the navigation system achieves the required precision. A waypoint resolution error must be less than or equal to 60 ft, including both the data storage resolution and the RNP system computational resolution used internally for construction of flight plan waypoints. The navigation database must contain vertical angles (flight path angles) stored to a resolution of hundredths of a degree, with a computational resolution such that the system-defined path is within 5 ft of the published path.

4) **"Direct to" function capability** - The navigation system must have a "direct to" function that the flight crew can activate at any time. This function must be available for any fix. The navigation system must also be capable of generating a geodetic path "to" the designated fix, without turns and undue delays.

5) **Ability to define a vertical path**.- The navigation system must be capable of defining a vertical path for a flight path angle to a fix. The navigation system must also be capable of specifying a vertical path between the altitude constraints of two fixes in the flight plan. Fix altitude constraints must be defined as one of the following:

(a) an AT or ABOVE altitude constraint (for example, 2400A) may be appropriate for situations where it is not necessary to limit the vertical path;

(b) an AT or BELOW altitude constraint (for example, 4800B) may be appropriate for situations where it is not necessary to limit the vertical path;

(c) an AT altitude constraint (for example, 5200); or

(d) a WINDOW-type altitude constraint (for example, 2400A3400B).

Note.- *For RNP AR APCH procedures, any segment with a published vertical path will define that path based on an angle to the fix and altitude.*

6) **Altitudes and/or speeds.-** Altitudes and speeds associated with published procedures must be extracted from the navigation database.

7) **Path construction.**- The system must be capable of constructing a path to provide guidance from current position to a constrained fix.

8) **Ability to load procedures from the navigation database.-** The navigation system must be capable of loading the entire procedure(s) to be flown into the RNP system from an on-board database. This includes the approach (including a vertical angle), the missed approach, and the approach transitions for the selected aerodrome and runway.

9) **Means to retrieve and display navigation data.-** The navigation system must provide the flight crew the ability to verify the procedures to be flown through a review of the data stored in the on-board navigation database. This includes the ability to review the data for individual waypoints and navigation aids.

10) **Magnetic variation.**- For paths defined by a course (path terminators: Course to a fix (CF) and Course from a fix to an altitude (FA)), the navigation system must use the magnetic variation value for the procedure loaded on the navigation database.

11) **Changes in the RNP value.**- Changes to lower RNP values must be completed at the fix that defines the leg with the lowest RNP value. Any operational procedure necessary to accomplish this must be identified.

12) **Automatic leg sequencing.**- The navigation system must provide the ability to automatically sequence to the next leg and display the sequencing to the flight crew in a readily visible manner.

13) **Display of altitude restrictions.**- A display of altitude restrictions associated to flight plan fixes must be available to the pilot. If there is a particular procedure in the navigation database with a flight path angle associated with any flight plan leg, the equipment must display the flight path angle for that leg.

c) **Demonstration of path steering performance.**- When the RNP demonstration includes a path steering performance demonstration (flight technical error), the applicant must complete such demonstration in keeping with paragraphs 5.19.2.2 and 5.19.3.1 of FAA AC 120-29A.

d) **Displays.-**

1) **Continuous display of deviation.-** The navigation system must provide the ability to continuously display the aircraft position relative to the defined RNP path (both lateral and vertical deviation) to the pilot flying the aircraft, on the primary flight navigation instruments. The display must allow the pilot to readily distinguish if the cross-track deviation exceeds the navigation precision (or a smaller value) or if the vertical deviation exceeds 75 ft (or a smaller value).

(a) It is advisable that a appropriately-scaled non-numeric deviation display (*e.g.,* the lateral deviation indicator or the vertical deviation indicator) be located in the primary field of view of the pilot. A course deviation indicator (CDI) is acceptable provided it demonstrates an appropriate scaling and sensitivity for the intended navigation precision and operation. With a scalable CDI, the scale should be derived from the RNP selection, and does not require a separate selection of the CDI scale. Alerting and annunciation limits must also match the scaling values. If the equipment uses a pre-established navigation precision to describe the operational mode (*e.g.,* en route, terminal area, and approach), then displaying the operational mode is an acceptable means from which the flight crew can derive the CDI scale sensitivity.

(b) Normally, a numeric deviation display or the display of a graph on a map without a properly regulated deviation indicator is not acceptable. The use of a numeric display or a map display may be possible depending on the flight crew workload, display characteristics, flight crew procedures and training. Furthermore, initial and recurrent training or on-line experience must be provided to the flight crew, but this solution increases flight crew workload during approach, and imposes additional costs to the operator due to training requirements.

2) **Identification of the active (to) waypoint.-** The navigation system must provide a display identifying the active waypoint, either in the primary field of view of the pilot or on a display

that is visible to, and of ready access by the flight crew.

3) **Display of distance and heading.-** The navigation system must provide a display of distance and heading to the active (to) waypoint in the primary field of view of the pilot. Where not viable, an easily accessible page on the control display unit (CDU), readily visible to the flight crew, may display the information.

4) **Display of groundspeed (GS) and time.-** The navigation system must provide a display of groundspeed and time to the active (to) waypoint in the primary field of view of the pilot. Where not viable, an easily accessible page on the control display unit, readily visible to the flight crew, may display the information.

5) **Display of to/from the active fix.-** The navigation system must provide a to/from display in the primary field of view of the pilot.

6) **Desired track display.-** The navigation system must be capable of continuously displaying the desired RNP track to the pilot flying the aircraft. The display must be on the primary flight instruments for aircraft navigation.

7) **Display of aircraft track.**- The navigation system must provide a display of the actual aircraft track (or track angle error), either in the primary field of view of the pilot, or on a display that is visible to, and readily accessible by the flight crew.

8) **Failure annunciation.-** The aircraft must provide a means to annunciate failures of any component of the RNP system, including navigation sensors. The annunciation must be visible to the pilot and located in the primary field of view of the pilot.

9) **Enslaved course selector.-** The navigation system must provide a course selector automatically enslaved to the computed RNP path.

10) **RNP path display.-** When the minimum flight crew is two pilots, the navigation system must provide a readily visible means for the pilot monitoring the aircraft to verify the defined RNP path and the aircraft position relative to said path.

11) **Display of distance to go.-** The navigation system must provide the ability to display distance to go to any waypoint selected by the flight crew.

12) **Display of distance between flight plan waypoints.**- The navigation system must provide the ability to display the distance between flight plan waypoints.

13) **Display of deviation.** The navigation system must provide a numeric display of vertical deviation with a resolution of 10 ft or less, and a lateral deviation with a resolution of 0.01 NM or less.

14) **Display of barometric altitude.**- The aircraft must display barometric altitude from two independent sources, one in the primary field of view of each pilot.

Note.- *This display supports an operational cross-check of altitude sources. If the aircraft altitude sources are automatically compared, the output of the independent altimetry sources, including independent aircraft static air pressure systems, must be analyzed to ensure that they can provide an alert in the primary field of view of the pilot when deviations exceed 75 ft. Such comparator monitor function shall be documented so that it may eliminate the need for an operational mitigation.*

15) **Display of active sensors.-** The aircraft must display the navigation sensor(s) in use. It is recommended that this display be provided in the primary field of view of the pilot.

Note.- *This display is used to support operational contingency procedures. If such display is not provided in the primary field of view of the pilot, flight crew procedures can mitigate the need for this display if the workload is designated as acceptable.*

e) **Design assurance**.- The system design assurance must be consistent with at least a major failure condition with respect to false lateral or vertical guidance during an RNP AR APCH.

Note.- *The false vertical or lateral RNP guidance display is considered to be a (severe or major) hazardous failure condition for RNP AR APCH with an RNP value of less than 0.3. Systems designated as consistent with this effect should be documented since they can eliminate the need for some aircraft operational mitigation.*

f) **Navigation database. –**

1) **Navigation database.-** The aircraft navigation system must use a navigation database that:

(a) can receive updates in accordance with the AIRAC cycle; and

(b) permits the retrieval and loading of RNP AR APCH procedures from and into the RNP system.

2) **Database protection.-** The on-board navigation database must be protected against flight crew modification of stored data.

Note.- *When a procedure is loaded into the database, the RNP system must fly the published procedure. This does not prevent the flight crew from having the means to modify a procedure or route that has been loaded into the RNP system. However, the procedures stored in the navigation database must not be modified and must remain intact in the navigation database for reference and future use.*

3) **Validity period display.-** The aircraft must provide a means to display the validity period of the on-board navigation database to the flight crew.

4. REQUIREMENTS FOR RNP AR APCH PROCEDURES WITH RF LEGS

This section defines the additional requirements for executing approaches with RF legs. The AFM or the aircraft qualification guidance shall state whether or not this capability is provided.

a) The navigation system must be capable of executing transition legs and maintaining tracks that are consistent with the RF legs between two fixes.

b) The aircraft must have an electronic map displaying the procedure selected.

c) The FMC, the flight management system, and the autopilot must be capable of commanding a bank angle of 25º above 400 ft AGL and up to 8º below 400 ft AGL.

d) Once a missed approach or go-around (through the activation of TOGA of other means) has been initiated, the flight guidance mode must remain in LNAV to enable continuous track guidance during an RF leg.

5. REQUIREMENTS FOR APPROACHES WITH AN RNP OF LESS THAN 0.3

The AFM or aircraft qualification guidance must state whether or not the ability of executing approaches with an RNP of less than 0.3 is provided for each aircraft configuration (*e.g.,* two APs may achieve an RNP capability that is lower to that achieved with two flight directors).

a) **Single point of failure.-** No single point of failure can cause the loss of guidance compatible with the RNP value of the approach. Typically, the aircraft must have at least the following equipment:

1) two GNSS sensors;

2) two FMS;

3) two air information systems;

4) two AP; and

5) one inertial reference unit (IRU).

b) **Design assurance.-** The system design assurance must be consistent with at least a severe or major failure condition due to loss of lateral or vertical guidance during an RNP AR APCH where an RNP value of less than 0.3 is required to avoid obstacles and terrain while executing an approach.

Note.- *The loss of lateral guidance display during RNP AR APCH operations that require an RNP value of less than 0.3 to avoid obstacles or terrain is considered as a hazardous (severe or major) failure condition. The AFM shall document designated systems that are consistent with this effect. This documentation shall describe the specific configuration of the aircraft or the mode of operation to obtain RNP values of less than 0.3. Compliance with this requirement may replace the general requirement for the two pieces of equipment described above.*

c) **Go-around guidance**.- Once a missed approach or go-around maneuver has been initiated

(through activation of TOGA or other means), the flight guidance mode must remain in LNAV to enable continuous track guidance during an RF leg. If the aircraft does not provide this capability, the following requirements apply:

1) If the aircraft provides RF leg capability, the lateral path after initiating a go-around maneuver (TOGA) (taking into account a straight segment of at least 50 seconds between the point where the RF leg ends and the decision altitude (DA)) must fall within 1º of the track defined by the straight segment through the DA point. The previous turn may have an arbitrary angular extension and a turn radius as small as 1 NM, with speeds consistent with the approach conditions and the turn radius.

2) The flight crew must be capable of coupling the AP or DF to the RNP system (connect LNAV) at 400 ft AGL.

d) **Loss of GNSS.-** After initiating a go-around or missed approach following loss of GNSS, the aircraft must automatically revert to another means of navigation that complies with the RNP value.

6. REQUIREMENTS FOR MISSED APPROACHES WITH RNP LESS THAN 1.0

The AFM or the aircraft qualification guidance shall identify if the aircraft can achieve an RNP value of less than 1.0 in a missed approach. The AFM or the aircraft qualification guidance shall also specify the aircraft configuration or operating mode required to obtain RNP values of less than 1.0 (*e.g.,* two APs may achieve an RNP capability that is lower than that achieved with two FDs).

a) **Single point of failure**.- No single point of failure can cause the loss of guidance compliant with an RNP value associated to a missed approach procedure. Typically, the aircraft must have at least the following equipment:

1) two GNSS sensors;

2) dual FMS;

3) two air information systems;

4) two APs; and

5) one IRU.

b) **Design assurance**.- The system design assurance must be consistent with at least one severe or major failure condition due to loss of lateral or vertical guidance during an RNP AR APCH where an RNP value of less than 1.0 is required to avoid obstacles and terrain while executing a missed approach.

Note.- *The loss of lateral guidance display during RNP AR APCH missed approach operations that require an RNP value of less than 1.0 to avoid obstacles or terrain is considered as a hazardous (severe or major) failure condition. The AFM shall document designated systems that are consistent with this effect. This documentation shall describe the specific aircraft configuration or operation mode to obtain RNP values of less than 1.0. Compliance with this requirement may substitute the general requirement for two pieces of equipment described above.*

c) **Go-around guidance**.- Once initiated a missed approach or go-around (through the activation of TOGA or other means), the flight guidance mode must remain in LNAV to enable continuous track guidance during an RF leg. If the aircraft does not provide this capability, the following requirements apply:

1) If the aircraft provides the ability for RF legs, the lateral path after initiating a go-around (TOGA) (taking into account a straight segment of at least 50 seconds between the point where the RF leg ends and the decision altitude (DA)), must be within 1º of the track defined by the straight segment through the DA point. The previous turn may have an arbitrary angular extension and a turn radius as small as 1 NM, with speeds consistent with approach conditions and turn radius.

2) The flight crew must be capable of coupling the AP or DF to the RNP system (connect LNAV) at 400 ft AGL.

d) **Loss of GNSS.-** After initiating a go-around or a missed approach following a loss of GNSS, the aircraft must automatically revert to another means of navigation that complies with the RNP value.

APPENDIX 3

NAVIGATION DATA VALIDATION PROGRAM

1. INTRODUCTION

The procedure stored in the navigation database defines the aircraft lateral and vertical guidance. Navigation database updates are done every 28 days. The navigation data used in each update are critical for the integrity of each RNP AR APCH procedure. Taking into account the reduced obstacle clearance associated with these approaches, navigation data validation requires special consideration. This appendix provides guidance on operator procedures to validate navigation data associated with RNP AR APCH operations.

2. DATA PROCESSING

a) In its procedures, the operator shall identify the person responsible for the navigation data updating process.

b) The operator must document a process to accept, verify, and load the navigation data into the aircraft.

c) The operator must place its documented data process under configuration control.

3. INITIAL DATA VALIDATION

The operator must validate each RNP AR APCH procedure before flying the procedure under instrument meteorological conditions (IMC) to ensure compatibility with the aircraft and make sure that the resulting paths correspond to the published procedure. The operator must at least:

a) compare the navigation data of the procedure to be loaded into the FMS with a published procedure.

b) validate the navigation data of the loaded procedure, either in the flight simulator or in the aircraft under visual meteorological conditions (VMC). The procedure outlined in a map display must be compared to the published procedure. The complete procedure must be flown to make sure that the path can be used, has no apparent lateral or vertical path inconsistenies, and is consistent with the published procedure.

c) Once the procedure is validated, a copy of the validated navigation data must be kept and maintained for comparison with subsequent data updates.

4. DATA UPDATES

Whenever a navigation data update is received and before using such data in the aircraft, the operator must compare the update with the validated procedure. This comparison must identify and resolve any discrepancy in the navigation data. If there are significant changes (any change affecting the approach path or performance) to any part of a procedure, and such changes are verified through the initial information data, the operator must validate the amended procedure in accordance with the initial data validation.

5. NAVIGATION DATA SUPPLIERS

Navigation data providers must have a letter of acceptance (LOA) in order to process these data (*e.g.,* FAA AC 20-153, Conditions for issuance of letters of acceptance for navigation data suppliers by the European Aviation Safety Agency – EASA or equivalent document). An LOA recognizes the data of a

supplier as those where the quality of the information, the integrity and quality management practices are consistent with the criteria of document DO-200A/ED-76. An operator supplier (for example, an FMS company) must have an LOA Type 2 and its respective suppliers must have an LOA Type 1 or 2. AAC may accept a LOA submitted by navigation data providers or submit its own LOA.

6. AIRCRAFT MODIFICATIONS (DATA BASE UP TO DATE)

If an aircraft system required for RNP AR APCH operations is modified (*e.g.*, software change), the operator is responsible for validating the RNP AR APCH procedures with the navigation database and the modified system. This may be accomplished without any direct evaluation if the manufacturer verifies that the modification has no effect on the navigation database or path computation. If there is no such verification by the manufacturer, the operator must conduct an initial navigation data validation with the modified system.

APPENDIX 4

OPERATING PROCEDURES

1. GENERAL

This appendix provides guidance on the execution of RNP AR APCH operations. In addition to the guidelines provided in this appendix, the operator must ensure continuous compliance with the general RNP AR APCH operating procedures and verification of notices to airmen (NOTAMs), NAVAID availability, aircraft system airworthiness, and flight crew qualification.

2. PRE-FLIGHT CONSIDERATIONS

a) **Minimum equipment list (MEL).-** The operator MEL must be developed or revised to indicate equipment requirements for instrument RNP AR APCH procedures. Guidance on these equipment requirements is available in the documents of the aircraft manufacturer. The required equipment may depend on the intended navigation precision and whether the missed approach requires an RNP value of less than 1.0. For example, GNSS and AP are normally required for a low navigation precision. Normally, dual equipment is required for approaches when using a line of minima of less than RNP 0.3 and/or when the missed approach has an RNP value of less than 1.0. An operable enhanced ground proximity warning system (EGPWS/TAWS) is required for all RNP AR APCH procedures. It is advisable that the EGPWS/TAWS use local pressure- and temperature-compensated altitudes (*e.g.,* a corrected GNSS and barometric altitude) and that it includes data on significant obstacles and terrain. The flight crew must be aware of the equipment requirement.

b) **Autopilot (AP) and flight director (FD).-** For procedures with a navigation precision of less than RNP 0.3 or with RF legs, the use of AP and FD driven by the aircraft RNP system is required in all cases. Therefore, the AP and FD must operate with a suitable precision to track the lateral and vertical paths required by a specific RNP AR APCH procedure. When the dispatch or release of a flight is predicated on flying an RNP AR APCH approach that requires the use of AP at the destination and/or alternate aerodrome, the flight dispatcher or pilot in command must make sure that the AP is installed and operational.

c) **Assessment of an RNP AR APCH dispatch or release.-** The operator must have a predictive performance capability to forecast whether the specific RNP will be available at the location and time of a desired RNP AR APCH operation. This capability can be provided through a ground service and does not need to reside in the aircraft avionic equipment. The operator must establish procedures requiring the use of this capability as a dispatch or release tool and as a flight-tracking tool in case of reported failures. RNP assessment must consider the specific combination of aircraft capabilities (sensors and integration).

   1) **Assessment of RNP AR APCH with GNSS updating**.- The predictive capability must take into account known and predicted temporary suspension of GNSS satellite service or other negative effects on navigation system sensors. The prediction program shall not use a masking angle of less than 5º, as operational experience indicates that satellite signals at low elevations are not reliable. The prediction must use the current GPS constellation with an algorithm identical to that used in the on-board equipment. For RNP AR APCH procedures in high terrain, the operator must use a masking angle appropriate to the terrain.

   2) From the initiation of the approach, RNP AR APCH procedures require GNSS updating.

d) **NAVAID exclusion**.- The operator must establish procedures to exclude air navigation facilities in accordance with published NOTAMs (*e.g.,* DMEs, VORs, and localizers). Rationality checks of the internal avionic equipment may not be appropriate for RNP AR APCH operations.

e) **Validity of the navigation database**.- Upon initiating the system, the pilots of aircraft equipped with certified RNP systems must confirm that the navigation database is valid. The databases are expected to be current for the duration of the flight. If the AIRAC cycle changes during the flight, the operators and pilots must establish procedures to ensure the precision of navigation data, including the suitability of navigation facilities used for defining routes and flight procedures. Traditionally, this has been accomplished by verifying electronic data against paper documents. One acceptable means is to compare aeronautical charts (new and old) to verify navigation fixes prior to flight dispatch or release. If an amended chart has been published for the procedure, the navigation database must not be used to conduct the operation.

3. FLIGHT CONSIDERATIONS

a) **Flight plan modification**.- Pilots are not authorized to fly a published RNP AR APCH procedure unless it can be retrieved by its name from the navigation database and conforms to the published procedure. The lateral path must not be modified, except that the pilot may accept a clearance to fly direct to a fix located prior the FAF in the approach procedure, and that does not immediately precede an RF leg. The only other acceptable modification to the loaded procedure is to change speed and/or altitude waypoint constraints on the initial, intermediate, or missed approach segments (for example, corrections applied due to cold temperature or to comply with an ATC clearance/instruction).

b) **Required equipment list**.- The flight crew must have a list of the equipment required to conduct RNP AR APCH procedures or alternate methods for addressing, during the flight, equipment failures that hinder the execution of an RNP AR APCH procedure (*e.g.,* the quick reference handbook - QRH).

c) **RNP AR APCH management**.- Flight crew operating procedures must ensure that the navigation system uses the appropriate navigation precision during the approach. If the approach chart shows several minima associated to different navigation precision values, the flight crew must confirm that the desired navigation precision has been entered in the RNP system. If the RNP system does not extract and set the navigation precision from the on-board database for each leg of the procedure, then the flight crew operating procedures must ensure that the lowest navigation precision required to complete the approach or missed approach has been selected before starting the approach.

d) **GNSS updating**.- From the beginning of the approach, all instrument RNP AR APCH procedures require GNSS updating of the navigation position solution. The flight crew must verify that GNSS updating is available before starting the RNP AR APCH procedure. If at any time during the approach GNSS updating is lost and the navigation system does not have the performance to continue the approach, the flight crew must abandon the RNP AR APCH procedure, unless the pilot has in sight the visual references required to continue such approach.

e) **Radio updating**.- The initiation of any RNP AR APCH procedure is based on GNSS updating. Except where specifically designated in a procedure as not authorized, DME/DME updating can be used as a reversal mode during the approach or missed approach when the system complies with the navigation precision. VOR updating is not authorized at this time. Consequently, the flight crew must follow operator procedures to inhibit specific facilities (see paragraph 2.d) of this appendix).

f) **Approach procedure confirmation**.- The flight crew must confirm that the correct procedure has been selected. This procedure includes the confirmation of waypoint sequence, the rationality of track angles and distances, and any other parameter that can be modified by the pilot, such as altitude and speed constraints. A procedure must not be used if validity of the navigation database is in doubt. A navigation system text display or a navigation map display can be used.

g) **Track deviation monitoring**.- Pilots must use a lateral deviation indicator, an FD and/or an AP in lateral navigation mode during RNP AR APCH procedures. Pilots of aircraft with lateral deviation indicators must ensure that indicator scaling (full-scale deflection) is suitable for the navigation precision associated with the various segments of the RNP AR APCH procedure.

All pilots are expected to maintain centre line procedures, as outlined in on-board lateral deviation indicators and/or in the flight guidance, during all RNP operations, unless authorized by the ATC to deviate or under emergency conditions.

For normal operations, the cross-track error/deviation (the difference between the path estimated by the RNP system and the aircraft position relative to the path) shall be limited to ± ½ the navigation precision associated with the procedure segment.

Small lateral deviations from this requirement (*e.g.,* overshooting or undershooting the limit) during or immediately after a turn are allowed, up to a maximum of 1 times (1xRNP) the navigation precision of the procedure segment.

The vertical deviation must be within 75 ft during the final approach segment. Lateral deviations shall be monitored above and below the glide path (GP). While being above the glide path provides a margin over the obstacles during the final approach, it can result in the pilot deciding to do a go-around closer to the runway, which reduces obstacle clearance during the missed approach.

Pilots must execute a missed approach if lateral deviation exceeds 1xRNP or if vertical deviation exceeds 75 ft, unless the pilot has in sight the visual references required to continue the approach.

1) Some aircraft navigation displays do not incorporate lateral and vertical deviations scaled for each RNP AR APCH operation in the primary field of view of the pilot. When using a moving map, a low-resolution vertical deviation indicator (VDI), or a numeric deviation display, flight crew training and procedures must ensure the effectiveness of these displays. Normally, this implies a demonstration of the procedure with a number of trained crews and the inclusion of this monitoring procedure in the recurrent training program for RNP AR APCH.

2) For aircraft using a CDI for lateral path tracking, the AFM or the aircraft qualification guidance shall indicate which navigation precision (RNP value) and operations the aircraft supports and the effects of the operation on CDI scale. The flight crew must know the CDI full-scale deflection (FSD) value. The avionics system can automatically adjust the CDI scale (depending on the flight phase) or the flight crew can manually adjust such scale. If the flight crew manually selects the CDI scale, the operator must have procedures in place and provide training to ensure that the CDI scale selection is appropriate for the intended RNP AR APCH operation. The deviation limit must be readily visible, considering CDI scale (*e.g.,* full-scale deflection).

h) **System cross-check**.- For RNP AR APCH procedures with a navigation precision of less than 0.3, the flight crew must monitor the lateral and vertical guidance provided by the RNP navigation system to ensure that this guidance is consistent with other available data and displays provided by an independent means.

Note.- *This cross-check may not be necessary if lateral and vertical guidance systems have been developed taking into account a hazardous (severe or major) failure condition due to false information (see Appendix 2, paragraph 3.e) and if normal system performance supports airspace containment (see Appendix 2, paragraph 2.d).*

i) **Procedures with RF legs**.- An RNP AR APCH procedure may require that aircraft be capable of executing an RF leg to avoid terrain and obstacles. Since not all aircraft have this capability, flight crews must know whether or not they can conduct these procedures. When flying an RF leg, flight crew compliance with the flight path is essential to maintain the track defined on the ground.

1) If a go-around maneuver is initiated during or immediately after an RF leg, the flight crew must be aware of the importance of maintaining the published path as closely as possible. The operator must develop and establish operating procedures for aircraft that do not stay in LNAV when a go-around maneuver is initiated, to ensure that the RNP AR APCH track defined on the ground is maintained.

2) Pilots must not exceed the maximum speeds shown in Table 4-1 during the RF leg. For example, an A 320 Category C must slow down to 160 KIAS at the final approach fix (FAF) or can fly as fast as 185 KIAS if using Category D minima. A missed approach prior to the decision altitude (DA) may require a segment speed for that segment to be maintained.

Table 4-1 – Maximum speed by segment and category

Indicated Airspeed (Knots)					
Segment	Indicated airspeed by aircraft category				
	Cat A	Cat B	Cat C	Cat D	Cat E
Initial and intermediate (IAF to FAF)	150	180	240	250	250
Final (FAF to DA)	100	130	160	185	As specified in the IAC
Missed approach (DA to MAHP)	110	150	240	265	As specified in the IAC
Airpeed restriction*	As specified in the IAC				

* Airspeed restrictions may be used to reduce turn radius regardless of aircraft category.

j) **Temperature compensation**.- For aircraft with temperature compensation capability as per paragraph 3.a)7) of Appendix 2 to this CA, flight crews may disregard temperature limits for RNP AR APCH procedures if the operator provides flight crews with training on the use of this capability. Temperature compensation through the aircraft system is applicable to VNAV guidance and is no substitute for flight crew compensating for cold temperature effects at minimum altitudes or the decision altitude. Flight crews must be familiar with the effects of temperature compensation when intercepting the compensated path described in documents EUROCAE ED-75B/RTCA DO-236B Appendix H.

k) **Altimeter setting**.- Due to reduced obstacle clearance inherent to instrument RNP AR APCH procedures, the flight crew must verify that the current local altimeter is set prior to the FAF but not prior to the IAF. The execution of an instrument RNP AR APCH procedure requires that the current altimeter be set for the aerodrome of intended landing. Remote altimeter settings are not allowed.

l) **Altimeter cross-check**.- Prior to the FAF, but not before the IAF, the flight crew must carry out a cross-check of both pilot altimeters to make sure they agree within $\pm$ 100 ft. If the cross-check fails, the crew must not continue with the approach. If the avionics system provides an automatic altitude comparison warning system for pilot altimeters, flight crew procedures shall indicate the action to be taken in the event of an altimeter comparator warning while executing an RNP AR APCH.

Note.- *This operational cross-check is not required if the aircraft system automatically compares altitudes to within 100 ft (see paragraph 3. d)15) of Appendix 2).*

m) **VNAV altitude transitions**.- The aircraft VNAV barometric system provides fly-by vertical guidance to ensure a smooth transition when intercepting the glide path prior to the FAF. Small vertical shifts, which may occur in a vertical constraint (*e.g.,* in the FAF), are considered operationally acceptable and desirable since they allow for the capture of a new or the next vertical segment. This temporary deviation below the published minima is acceptable as long as the deviation is limited to no more than 100 ft and is the result of a normal VNAV capture. This applies to both “leveling” and “altitude capture” segments that follow a climb or descent or vertical climb or beginning of a segment with descent, or when climb and descent paths with different slopes come together.

n) **Non-standard climb gradient**.- When the operator intends to use a DA associated with a missed approach non-standard climb gradient, it must ensure that the aircraft will be able to comply with the climb gradient published for the expected weight (mass) of the aircraft, atmospheric conditions, and operating procedures before conducting the operation. When the operator has performance personnel available to determine whether its aircraft can meet the published climb gradients, such personnel must provide information to pilots about the climb gradients that they must comply with.

o) **Engine-out procedures**.- Aircraft may demonstrate an acceptable flight technical error (FTE) with one engine inoperative when conducting RNP AR APCH procedures. Otherwise, flight crews are expected to take appropriate action in case of an engine failure during an approach, so no specific aircraft qualification is required in this case. The aircraft qualification must identify any performance limitation in case of engine failure to support the definition of the appropriate flight crew procedures. Operators must pay special attention to published procedures with non-standard climb gradients.

p) **Missed approach or go-around**.-

1) **Missed approach procedure requiring RNP 1.0**.- Where possible, the missed approach will require RNP 1.0. The missed approach of these procedures is similar to the missed approach of an RNP APCH operation.

2) **Missed approach procedures requiring RNP of less than 1.0**.- When necessary, RNP values of less than 1.0 will be used in the missed approach. For an operator to be approved to execute these approaches, the equipage and procedures must meet the criteria established in paragraph 6 of Appendix 2 (Requirements for missed approaches with an RNP of less than 1.0).

3) In many aircraft, a change may occur in lateral navigation when TOGA is activated during a missed approach or go-around. Also, in many aircraft, TOGA activation disconnects the AP and FD from LNAV guidance, and the FD reverts to track-hold derived from the inertial system. LNAV guidance to the AP and FD shall be re-engaged as quickly as possible.

4) Flight crew procedures and training programs must address the impact on navigation capability and flight guidance if the pilot initiates a go-around during a turn. In the event an early missed approach is initiated, the flight crew must follow the approach and missed approach tracks unless otherwise cleared by the ATC. The flight crew shall also be aware that RF legs are designated based on the maximum true speed at normal altitudes, and initiating an early missed approach will reduce the maneuverability margin, and will potentially make it impractical to hold the turn at missed approach speeds.

5) Upon loss of GNSS updating, the RNP guidance may begin to navigate on IRU, if installed on the aircraft, but the aircraft will begin to drift, degrading the navigation position solution. Therefore, when RNP AR APCH missed approach operations are based on IRU autonomous navigation, the inertial guidance can only provide RNP guidance for a specific amount of time.

q) **Contingency procedures**.-

1) **Failure while en route**.- The aircraft RNP capability is dependent upon operational equipment and GNSS satellites. Before initiating the approach, the flight crew must be capable of assessing the impact of equipment failure on the RNP AR APCH procedure and take the appropriate corrective action. As stated in paragraph 2.c) of this appendix, the flight crew must also be capable of assessing the impact of changes in GNSS constellation and take appropriate corrective action.

2) **Failure on approach**.- The operator contingency procedures must cover at least the following conditions:

(a) RNP system components failures, including those affecting lateral and vertical deviation performance (*e.g.,* failures of GPS sensors, AP or FD).

(b) Loss of navigation signal-in-space (loss or degradation of external signal).

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APPENDIX 5

TRAINING PROGRAM

1. INTRODUCTION

The operator must provide training for key personnel on the use and application of RNP AR APCH procedures (for example, flight crews, flight dispatchers, performance engineers, and maintenance personnel). A full understanding of operating procedures and best practices is crucial for safe aircraft operation during RNP AR APCH procedures. The training program must provide sufficient detail on aircraft navigation and flight control systems to enable the flight crew to identify failures affecting their RNP capability and apply the appropriate normal, non-normal, and emergency procedures. The required training must include both knowledge and evaluation of skills acquired by flight crews, flight dispatchers, performance engineers, and maintenance personnel.

a) **Flight crew training**.-

1) Each operator is responsible for providing flight crews with training on the specific RNP AR APCH operations it conducts. The operator must include training on the various types of RNP AR APCH procedures and the equipment required. Training must include a discussion of regulatory requirements. The operator must include these requirements and procedures in its operating and training manuals as applicable. This material must address all aspects of RNP AR APCH procedures conducted by the operator, including the applicable operational authorization (*e.g.,* operational specifications (OpSpecs)). An individual must have completed the appropriate ground and/or flight training segments before participating in RNP AR APCH procedures.

2) Flight training segments must include training and verification modules representative of the type of RNP AR APCH operations the operator conducts during airline activities. Many operators can provide training in RNP AR APCH procedures in keeping with the training provisions and standards established by advanced qualification programs (AQP). Operators can also do assessments in line-oriented flight training (LOFT) and selected-event training (SET) scenarios or in a combination of both. The required flight training modules can be conducted in flight training devices (FTD), flight simulators, and other enhanced training devices, as long as these training media accurately replicate operator equipment and RNP AR APCH operations, and are CAA-approved.

b) **Qualification training for LAR 91, 121, and 135 flight crews**.-

1) Operators must refer to RNP AR APCH training and qualification modules during initial, transition, upgrade, recurrent, discrepancy, re-qualification, and autonomous (self-teaching) training, in keeping with the approved training programs. The skill of each pilot to understand and properly use RNP AR APCH procedures will be assessed based on qualification standards (initial RNP AR APCH assessment). The operator must also develop recurrent qualification standards to ensure its flight crews properly maintain their knowledge of, and proficiency in RNP AR APCH operations (RNP AR APCH recurrent qualification).

2) Operators may address RNP AR APCH topics separately or integrated with other curriculum elements. For example, a flight crew qualification may focus on a specific aircraft during transition, upgrade, or discrepancy courses. General training must also address RNP AR APCH qualification (*e.g.,* during recurrent training or verification events such as proficiency checks (PC), proficiency training (PT), line-oriented evaluations (LOE), or special-purpose operational training (SPOT)). A separate, independent RNP AR APCH qualification program can also address RNP AR APCH training (*e.g.,* by completion of a special RNP AR APCH curriculum at an operator training centre or designated crew bases).

3) **Credit for using the approved RNP training program of an operator in service**.- Operators intending to receive credit for RNP training, when their proposed program relies on previous RNP training (for example, special instrument approach procedures (IAPs)), must receive specific authorization from their principal operations inspector (POI). In addition to the current RNP training program, the operator must provide training on discrepancies between the existing training program and RNP AR APCH training requirements.

4) **Flight dispatcher training**.-

(a) Training for flight dispatchers must include:

(1) training on the different types of RNP AR APCH procedures;

(2) the importance of specific navigation and other equipment during RNP AR APCH operations, and regulatory RNP AR APCH procedures and requirements.

(b) Flight dispatcher procedures and training manuals must include the requirements of paragraph (a) above.

(c) Training must also cover all aspects of RNP AR APCH operations conducted by the operator, including applicable authorizations (*e.g.,* OpSpecs, operations manual, LOA).

(d) A dispatcher must have completed the appropriate training course before participating in RNP AR APCH operations.

(e) Additionally, dispatcher training must address how to determine:

(1) RNP AR APCH availability (taking into account equipment capabilities);

(2) MEL requirements;

(3) aircraft performance; and

(4) navigation signal availability (*e.g.,* GPS RAIM, RNP capability predictive tools) for destination and alternate aerodromes.

2. GROUND TRAINING SEGMENTS

The ground segment of the RNP AR APCH training program must include modules addressing the following subjects during the initial introduction of RNP AR APCH operations and systems for flight crews. For recurrent training programs, the training curriculum needs only to review the initial curriculum requirements and address new, revised, or emphasized aspects of RNP AR APCH operations.

a) **General concepts of RNP AR APCH operations**.- RNP AR APCH academic training must address the theory behind RNP AR APCH systems to the extent appropriate to ensure proper operational use. Flight crews must understand the basic operational concepts of RNP AR APCH systems, its classifications and limitations. Training must include general knowledge and operational application of instrument RNP AR APCH procedures. This training module must address the following specific elements:

1) definition of RNAV, RNP, RNP AR APCH;

2) the difference between RNAV and RNP;

3) the types of RNP AR APCH procedures and familiarity with the charts for these procedures;

4) RNP programming and display and aircraft-specific displays (*e.g.,* current navigation performance);

5) how to enable and disable RNP-related navigation updating modes;

6) the appropriate navigation precision for the different flight phases and RNP AR APCH procedures, and how to select it (if required);

7) the use of GPS RAIM (or equivalent) forecasts and the effects of RAIM availability on RNP AR APCH procedures (flight crews and dispatchers);

8) when and how to terminate RNP navigation and transfer to traditional navigation due to loss of RNP and/or the required equipment;

9) how to determine database validity and whether it contains the required navigation data for using waypoints;

10) explanation of the different components that contribute to the total system error and their characteristics (*e.g.,* the effect of temperature on barometric vertical navigation (baro-VNAV), drift characteristics when using IRU with no radio updating);

11) Temperature compensation. Flight crews operating avionics systems with a compensation function may disregard temperature limits on RNP AR APCH procedures if the operator provides flight crew training on the operation of such function and crews use the function. The training must indicate that temperature compensation through the aircraft system is applicable to VNAV guidance and is not a substitute for flight crew compensating for cold temperature effects on minimum altitudes or the decision altitude.

Note 1.- *Pilots are responsible for all low (cold) temperature corrections required at all published minimum altitudes/heights. This includes:*

- altitudes/heights for initial and intermediate legs;
- the DA/H; and
- subsequent missed approach altitudes/heights.

Note 2.- *The VPA of the final approach path is protected against the effect of low temperatures by the procedure design.*

b) **ATC communications and coordination for conducting RNP AR APCH operations**.- Ground training must instruct the flight crew on flight plan classification, any ATC procedure applicable to RNP AR APCH operations, and the need to advise ATC immediately when the performance of the aircraft navigation system is no longer suitable to support continuation of an RNP AR APCH procedure. The flight crew must know that navigation sensors are part of the basis for RNP AR APCH compliance, and must be capable of assessing the impact of failure of any avionics equipment or ground navigation systems and services on flight plan compliance.

c) **RNP AR APCH equipment components, controls, displays, and alerts**.- Academic training must cover RNP terminology, symbols, operation, optional controls, and display features, including aspects that are specific to the operator implementation or systems. Training must address applicable alerts and limitations. Flight crews and dispatchers should achieve full understanding of the equipment used in RNP operations and any limitations on the use of the equipment during these operations.

d) **AFM operating procedures and information**.- The AFM or other evidence of aircraft eligibility must address normal and non-normal flight crew operating procedures, responses to failure alerts, and any limitation, including information related to RNP modes of operation. Training must also address contingency procedures for loss or degradation of RNP capability. The accepted or approved operations manuals, including the aircraft operations manual (AOM/FCOM) and the pilot operations handbook (POH), must contain this information in the corresponding sections.

e) **MEL provisions**.- Flight crews must have a full understanding of MEL requirements supporting RNP AR APCH operations.

3. FLIGHT TRAINING SEGMENTS

In addition to academic training, flight crews must receive appropriate operational training. Training programs must address the proper execution of RNP AR APCH procedures according to the documentation of the original equipment manufacturer (OEM). The operational training must include RNP AR APCH procedures and limitations, standardization of cockpit electronic display configuration

during an RNP AR APCH procedure, recognition of aural warning signals, alerts, and other annunciations that can affect compliance of an RNP AR APCH procedure, and timely and effective responses to loss of RNP AR APCH capability in a variety of scenarios embracing the breadth of RNP AR APCH procedures that the operator plans to execute. Flight training may use approved FTDs or flight simulators. This training must include the following specific elements:

a) procedures for verifying that each pilot altimeter has a valid setting before initiating the final approach in an RNP AR APCH procedure, including any operational limitations associated with the source(s) for altimeter setting and the latency of checking and setting the altimeters upon approaching the FAF;

b) use of RADAR, EGPWS (TAWS), or other avionics systems to support track monitoring and avoidance of obstacles and adverse weather by the flight crew;

c) the effect of wind on aircraft performance during RNP AR APCH procedures and the need to remain within the containment area, including any operational limitations due to wind, and the essential aircraft configuration to safely complete an RNP AR APCH procedure;

d) the effect of ground speed on compliance with RNP AR APCH procedures, and bank angle constraints that hinder the ability to remain on the centre line of the course;

e) the relationship between RNP and the appropriate line of approach minima on a published RNP AR APCH procedure, and any operational limitation if the available RNP degrades o is not available prior to the approach (this includes flight crew procedures outside the FAF *versus* inside the FAF);

f) complete and concise flight crew briefings on all RNP AR APCH procedures and the important role cockpit resource management (CRM) plays on successfully completion of an RNP AR APCH procedure;

g) data insertion alerts and use of a wrong navigation precision for a desired segment of an RNP AR APCH procedure;

h) performance requirements for coupling the AP/FD to the navigation system lateral guidance on RNP AR APCH procedures requiring an RNP of less than 0.3;

i) the importance of aircraft configuration to ensure that it maintains any required speed during RNP AR APCH procedures;

j) the events that trigger a missed approach when using aircraft RNP capability;

k) any bank angle constraint or limitation on RNP AR APCH procedures;

l) the potentially detrimental effect of reducing flap setting, reducing the bank angle, and increasing airspeed on the ability to comply with an RNP AR APCH procedure.

m) the knowledge and skills required by the flight crew to properly conduct RNP AR APCH operations;

n) the programming and operation of the FMC, AP, auto-throttles, RADAR, GPS, INS, EFIS (including a moving map), and EGPWS (TAWS) in support of RNP AR APCH procedures;

o) the effect of activating TOGA during a turn;

p) FTE monitoring and its effect on go-around decision and execution;

q) loss of GNSS during a procedure;

r) performance aspects associated with reversal to radio position updating, and limitations on the use of DME and VOR updating;

s) flight crew contingency procedures for loss of RNP capability during a missed approach. Due to lack of navigation guidance, training must emphasize the contingency actions that the flight crew must take to achieve separation from the ground and obstacles. The operator must tailor these contingency procedures to the specific RNP AR APCH procedures;

t) as a minimum, each pilot must complete two RNP AR APCH procedures using the unique

characteristics of the approved procedures of the operator (*e.g.,* RF legs, loss of RNP). One procedure must culminate in a transition to landing and another procedure must culminate in the execution of an RNP missed approach procedure.

4. EVALUATION MODULE

a) **Initial evaluation of RNP AR APCH procedures and knowledge**.- The operator will evaluate the knowledge that each member of the flight crew has with respect to RNP AR APCH procedures before they use these procedures. As a minimum, this must include a complete evaluation of pilot procedures and the specific performance requirements for RNP AR APCH operations. An acceptable means for this initial evaluation includes one of the following:

1) An evaluation by an authorized instructor evaluator or an operator inspector, using an simulator or training device.

2) An evaluation by an authorized instructor evaluator or an operator inspector during on-line operations, training flights, proficiency check (PC) or proficiency training (PT) events, operational experience (OE), en-route checks and/or on-line checks.

3) Line-oriented flight training (LOFT)/line-oriented evaluation (LOE).- LOFT/LOE training programs using an approved simulator that incorporates RNP operations with the unique RNP AR APCH characteristics (*e.g.,* RF legs, loss of RNP) of the approved procedures of the operator.

b) **Specific elements of the evaluation module.-** The specific elements that must be included in the evaluation module are:

1) Demonstrate the use of any RNP limits/minima that might affect various RNP AR APCH operations.

2) Demonstrate the application of position radio updating procedures, such as enabling and disabling FMC ground-based radio updating (*e.g.,* DME/DME and VOR/DME updating), and knowledge of when to use this feature. If aircraft avionics does not include the capability of disabling radio updating of the position, then training must ensure the flight crew is capable of adopting operational measures to mitigate the lack of this feature.

3) Demonstrate the ability to monitor the lateral and vertical flight paths relative to the programmed flight path, and complete the appropriate flight crew procedures when exceeding an FTE lateral or vertical limit.

4) Demonstrate the ability to read and interpret a RAIM (or equivalent) forecast, including forecasts predicting RAIM unavailability.

5) Demonstrate how to properly configure the FMC, the weather RADAR, EGPWS (TAWS), and the moving map for the various RNP AR APCH operations and scenarios that the operator intends to implement.

6) Demonstrate the use of flight crew briefings and checklists for RNP AR APCH operations, with emphasis on CRM.

7) Demonstrate knowledge and skills to conduct an RNP AR APCH missed approach procedure in a variety of operating scenarios (*e.g.,* loss of navigation or failure to obtain visual conditions).

8) Demonstrate speed control during segments requiring speed restrictions to ensure compliance with the RNP AR APCH procedure.

9) Demonstrate proficient use of instrument approach charts (IAC), briefing cards, and checklists.

10) Demonstrate the ability to complete a stable RNP AR APCH procedure: bank angle, speed control, and staying on the centre line of the procedure.

11) Know the operational limit for deviations below the desired flight path on an RNP AR APCH procedure and how to precisely monitor the aircraft position relative to the vertical path.

5. RECURRENT TRAINING ON RNP AR APCH KNOWLEDGE AND PROCEDURES

a) **RNP AR APCH recurrent training**.- In its training program, the operator must incorporate recurrent RNP training and evaluation covering the unique characteristics of RNP AR APCH operations with respect to the approved procedures.

b) Each pilot must fly a minimum of two RNP AR APCH procedures in each duty position (pilot flying the aircraft (PF) and pilot monitoring the aircraft (PM)), with one approach culminating in a complete landing and one culminating in a missed approach.

Note.- *Equivalent RNP approaches may be credited toward compliance of the requirement for two RNP AR APCH procedures.*

APPENDIX 6

RNP AR APCH MONITORING PROGRAM

1. The operator must have an RNP AR APCH monitoring program to ensure continued compliance with the guidelines of this AC and to identify any negative performance trends. As a minimum, the monitoring program will include the following activities: During the provisional approval, the operator must submit the following information every 30 days to the authority that issued the authorization. Subsequently, it will continue collecting information and periodically reviewing it to identify potential safety risks. It will also maintain a summary of the processed information.

a) Total number of RNP AR APCH procedures executed.

b) Number of satisfactory approaches per aircraft and system (they are considered satisfactory if completed as planned without any anomalies in the navigation or guidance system).

c) Reasons for unsatisfactory approaches, such as:

   1) UNABLE REQ NAV PERF, NAV ACCUR DOWNGRAD, or other messages activated during the approach;

   2) Excessive lateral or vertical deviation;

   3) EGPWS (TAWS) warning;

   4) Disconnection of the AP system;

   5) Navigation data errors; and

   6) Reports of anomalies by the pilot.

d) Comments by the crew.

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APPENDIX 7

REQUIREMENTS FOR OBTAINING RNP AR APCH AUTHORIZATION

In order to obtain operational approval, the operator will take the following steps, taking into account the criteria established in paragraphs 7, 8, 9, and 10 and in Appendices 2, 3, 4, 5, 6, 8, and 9 to this AC.

a) *Airworthiness approval*.- Aircraft shall have the corresponding airworthiness approvals as established in paragraphs 8 and 9 of this AC.

b) *Application*.- The operator shall submit the following documentation to the CAA:

1) *The application for RNP AR APCH operational approval*.

2) *Aircraft qualification documentation*.- The documentation of the manufacturer demonstrating that the proposed aircraft equipment meets the requirements of this AC as described in Appendix 2. This documentation shall contain hardware and software requirements, procedural requirements, and limitations.

3) *Type of aircraft and description of aircraft equipment to be used*.- The operator will provide a configuration list with details of the relevant components and the equipment to be used in the operation. The list shall include each manufacturer, model, and version of software installed in the FMS.

4) *Operational procedures and practices*.- The operator manuals must properly describe the characteristics of the intended area of operation and operational (navigation) practices and procedures identified in Appendix 4 to this AC. LAR 91 operators shall confirm that they will operate using identified practices and procedures.

5) *Navigation data validation program*.- The details of the navigation data validation program are described in Appendix 3 to this AC.

6) *Flight crew training program*.- According to Appendix 5 to this AC, operators must submit the training syllabi and other appropriate teaching material to demonstrate that operations have been incorporated into their programs. Training programs must properly address the special characteristics of the intended area of operation and (navigation) operational practices and procedures identified in Appendix 4 to this AC.

7) *Flight simulator training*.- Operators must submit a description of the training to be provided using simulation, the credits to be granted to simulation, the simulator qualification, and how this training will be used for on-line pilot qualification. Normally, this training will be included in the flight crew training program.

8) *Training programs for dispatchers and flight trackers*.- Operators will submit the training syllabi and other appropriate teaching material to demonstrate that this personnel has been incorporated into its programs as established in Appendix 5 to this AC.

9) *Instruction program for maintenance program.*- Operators will submit instruction syllabus corresponding to maintenance personnel.

10) *Operation manuals and checklists*.- Operators will submit the operation manuals and checklists containing information and guidance for the operations requested.

11) *Maintenance procedures*.- The operator will submit the maintenance procedures containing airworthiness and maintenance instructions for the systems and equipment to be used in the operation. The operator will provide a procedure for withdrawing and then restoring RNP AR APCH operational capability on the aircraft.

12) *RNP AR APCH monitoring program*.- The operator must submit a program for collecting data on executed RNP AR APCH procedures. Each operation must be recorded and unsatisfactory attempts must include the factors that prevented the successful completion of an operation.

13) *MEL*.- The operator will submit any revision to the MEL that is required for the conduction of operations.

14) *Validation*.- The operator will submit a validation test plan to demonstrate its ability to conduct the intended operation (see Chapter 13 of Volume II, Part II, of the SRVSOP Operations Inspector Manual (OIM)). The validation plan shall at least include the following:

(a) a statement that the validation plan has been designated to demonstrate the capability of the aircraft to execute RNP AR APCH procedures;

(b) the operational and dispatch procedures of the operator;

(c) the effectiveness of the operator training program;

(d) the effectiveness of maintenance procedures; and

(e) MEL procedures.

Note 1.- *The validation plan shall benefit from ground training devices, flight simulators, and aircraft demonstrations. If validation is done on board an aircraft, it must be done during in daytime and in VMC.*

Note 2.- *Validations may be required for each manufacturer, model and version of software installed in the FMS.*

15) *Conditions or limitations necessary or required for authorizations*.- The operator will submit any condition or limitation necessary or required for the authorizations.

16) *Flight operational safety assessment (FOSA).*- The operator will submit the methodology and process developed.

c) *Training*.- Once the amendments to the manuals, programs, and documents submitted have been accepted or approved, the operator will provide the required training to its personnel.

d) *Validation flights*.- Validation flights will be conducted in keeping with paragraph b) 13) above.

e) *Issuance of provisional authorization to conduct RNP AR APCH operations*.- Once the operator has completed the operational approval process, the CAA will issue the provisional authorization for the operator to conduct RNP AR APCH operations.

1) *LAR 91 operators*.- For LAR 91 operators, the CAA will issue a letter of acceptance (LOA) containing a provisional authorization to conduct RNP AR APCH operations according to the guidelines of this AC.

2) LAR 121 and/or 135 operators.- For LAR 121 and/or LAR 135 operators, the CAA will issue the corresponding OpSpecs reflecting the RNP AR APCH provisional authorization.

f) *Issuance of final approval*.- The CAA will issue the amended OpSpecs or the amended LOA authorizing the use of the lowest applicable minima, once the operators have satisfactorily completed the time period and the number of approaches required by the CAA, in keeping with paragraph 9.1 of this AC.

APPENDIX 8

RNP AR APCH Approval Process

a) The RNP AR APCH approval process encompasses the airworthiness and the operational approval. Although the two have different requirements, they must be considered within the same process.

b) This process constitutes an orderly method used by CAAs to ensure that applicants meet the established requirements.

c) The approval process is made up by the following phases:

1) Phase one: Pre-application

2) Phase two: Formal application

3) Phase three: Review of documentation

4) Phase four: Inspection and demonstration

5) Phase five: Approval

d) In *Phase one - Pre-application*, the CAA meets with the applicant or operator (pre-application meeting), who is advised of all the requirements it must meet during the approval process.

e) In *Phase two - Formal application*, the applicant or operator submits the formal application, accompanied by all the relevant documentation, in keeping with Appendix 7 to this AC.

f) In *Phase three - Review of documentation*, the CAA evaluates the documentation and the navigation system to determine their admissibility and the approval method to be applied with respect to the aircraft. As a result of this review and evaluation, the CAA may accept or reject the formal application together with the documentation.

g) In *Phase four - Inspection and demonstration*, the operator will train its personnel and implement the validation plan.

h) In *Phase five - Approval*, the CAA issues the RNP AR APCH provisional authorization once the operator has met the airworthiness and operational requirements. For LAR 121 and 135 operators, the CAA will issue the OpSpecs, and for LAR 91 operators, it will issue an LOA.

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APPENDIX 9

FLIGHT OPERATIONAL SAFETY ASSESSMENT (FOSA)

1. INTRODUCTION

The objective of RNP AR APCH procedures is to provide safe flight operations. Traditionally, safety has been defined by a target level of safety (TLS) and specified as a collision risk of 10^{-7} per approach. For RNP AR APCH operations, a different methodology, known as flight operational safety assessment (FOSA) is used. The FOSA is intended to provide a safety level that is equivalent to the traditional TLS.

With the FOSA, the safety objective is met by taking into account more than just the aircraft navigation system. The FOSA combines quantitative and qualitative analyses and evaluations of the navigation systems, aircraft systems, operational procedures, hazards, failure mitigations, normal, rare-normal and non-normal conditions, and the operational environment.

The FOSA relies on aircraft qualification, operational approval, and instrument procedure design criteria to address mostly the general technique, procedures and factors of the process. Additionally, operational expertise, technique and experience are required to conduct and complete the FOSA.

This appendix provides an overview of hazards and mitigations to assist States in applying these criteria. Safety of RNP AR APCH operations rests with the operator and the air navigation service provider (ANSP), as described in this appendix.

A FOSA must be conducted for RNP AR APCH procedures when the specific aircraft characteristics, operational environment, obstacles, etc., warrant the conduction of an additional assessment to ensure that safety objectives are met. This assessment must give proper attention to the inter-dependence of design, aircraft capability, crew procedure, and operational environment elements.

The FOSA is a key part of the operational authorization for RNP AR APCH procedures. This methodology is associated with a specific type of aircraft or a specific performance, and may be applied to a demanding environment.

2. BACKGROUND

a) La FOSA is used to make a safety case for RNP AR APCH operations. This methodology was developed in response to the following factors:

   1) System and aircraft certification and demonstration to determine their performance and capabilities are related to rules and criteria in force at a given point in time. This condition establishes a safety basis for aircraft operations. As a result, the aircraft is known to be safe if related to known airspace types, operations, and infrastructures.

   2) Throughout time, operators and ANSPs have developed new and novel operational solutions to the problems or limitations encountered in general flight operations.

   3) The implementation of new and novel procedures allows aircraft and systems to operate in a way that varies from the original design and aircraft capability approvals.

   4) In some cases, a new application or operational procedure exposes the aircraft to failures and hazards that were not considered in the basic system design and in the approval.

   5) Normally, airworthiness guidelines cannot keep pace with the new and original operational applications. The FOSA helps to address this issue.

b) The significant difference between the FOSA and other safety analysis tools is that this methodology applies a technical judgment based on combined qualitative and quantitative assessments of aircraft and flight operations. This means that the FOSA is not a safety analysis, or a risk analysis, or a risk model.

c) While the FOSA must consider risk estimates and exposures due to specific hazards and failures, the main aspect of the assessment is confidence on the technical judgment to determine acceptable mitigations for hazards or failures.

d) Although the FOSA has recently been formalized as a process in connection with RNP AR APCH operations, it has been extensively applied to assess particular cases, like the operations of a customer whose procedure design may significantly differ from the standard, and where there is a significant dependence on aircraft capability and performance. What the FOSA really offers is a process that repeats itself and a high level of standardization of case considerations and conditions.

3. DOCUMENTATION RELATED TO THE FOSA AND RNP AR APCH OPERATIONS

The FOSA is part of the total data package that must be compiled or created when an operator wishes to obtain an operational approval for RNP AR APCH procedures. Most of the aspects of the following RNP AR APCH package must be compiled or at least defined before conducting the FOSA.

a) *Aircraft capability and qualification;

b) Design of procedures, airspace, and intended operations;

c) Identification of non-standard aspects of procedure design;

d) *Identification of any special aircraft capability or performance requirements;

e) Description of the aerodrome and operation in the airspace;

f) Air traffic environment and operations;

g) *Maintenance process and procedures;

h) *Dispatch guidance and procedures;

i) *Training (flight crews, operations, air traffic, dispatch, recurrent training);

j) *Flight crew procedures;

k) *AR operations monitoring program; and

l) *Minimum equipment list

Most of the material with an asterisk (*) may have been developed to support aircraft type design or as part of the operational approval. In any case, specific acceptable means of compliance have been developed in this AC or in equivalent documents, like FAA AC 90-101 and AMC 20-26.

4. THE FOSA PROCESS

The FOSA process depends on the following factors:

a) a group of experts that includes;

   1) the operator (flight operations, dispatch, maintenance, inspectors, safety, quality system, etc.),

   2) air traffic services (ATC controller, airspace planner, principal operations inspectors, safety management, etc.);

   3) regulators; and

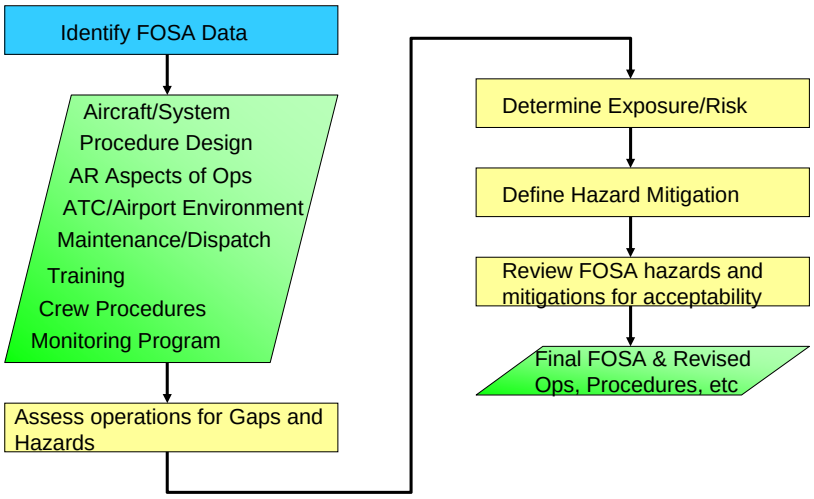
   4) experts on aircraft and system technical support.

b) a process leader capable of facilitating the guiding the review;

c) access to, or direct knowledge of the information required in paragraph 3; and

d) the process steps described in Table 9-1 – FOSA Process Steps:

Table 9-1 – FOSA Process Steps



5. FOSA PREPARATION

As documents and the data package are being organized and developed, the operator must review specific data or relevant information for the FOSA, including some of the following aspects:

a) What are the operational requirements or objectives?

b) What is the operational environment?

c) How do the aircraft operational and functional capabilities conform to procedure design requirements?

d) What specific system performance assessments and analyses have been performed to support aircraft qualification?

e) Are services and infrastructure suitable for the RNP AR APCH operation?

f) What RNP training is currently provided to flight crews and ATC?

g) What are the flight crew procedures for RNP operations?

h) How are RNP navigation specifications incorporated into ATS operations?

6. FLIGHT OPERATIONAL SAFETY ASSESSMENT (FOSA)

6.1 General.-

As part of the application package of the operator for RNP AR APCH operations, the FOSA shall contain:

a) An introduction or overview;

b) A description of the safety assessment process and criteria used;

c) A description of the system and of the RNP AR APCH operation assessed;

d) The identification of risk areas, hazards and severity;

e) Mitigation of risks; and

f) Conclusions and recommendations.

6.2 Assessment criteria.-

a) The FOSA shall identify the specific conditions or hazards associated with the aircraft, aircraft performance, navigation services, ATC, flight crew, operations of the operator, procedures, etc. In many cases, the total package of identified potential hazards will include many of the hazards already identified through aircraft certification, operator procedures, and air traffic operations.

b) Some times, the FOSA may contain several of the hazards contemplated in the aircraft system safety analysis. In this case, the assessment helps to make the safety case rather than to re-analyze aircraft airworthiness. Additionally, this reduces the probability of multiple mitigations for a risk that requires a single mitigation.

c) The FOSA applies the qualitative technique and operational experience, as well as technical judgment and relevant data availability. The assessment of findings regarding risk severity and likelihood shall follow the criteria contained in Table 9-2 – Risk severity and likelihood of success, which is based on ICAO Doc 9859 – Safety Management Manual.

Table 9-2 – Risk Severity and Likelihood of Occurrence

Risk Severity		**Likelihood of Occurrence**	
Level		**Probability**	
Catastrophic	Equipment destroyed Multiple casualties	Frequent	Likelihood of occurring many times
Hazardous	Significant reduction of safety margins, physical suffering or workload such that there can be no confidence in the operators precisely or fully performing their tasks. Several casualties or seriously injured. Significant damage to the equipment.	Occasional	Likelihood of occurring some times
Significant (Major)	Significant reduction of safety margins, reduction of operator ability to face adverse operational conditions due to an increased workload or conditions hindering efficiency. Serious incident. Injured individuals.	Remote	Not very likely, but possible.
Of little importance (Minor)	Nuisance. Operational limitations. Use of emergency procedures. Minor incident.	Unlikely	Its occurrence is very unlikely.
Negligible	Of little consequence.	Extremely unlikely	Its occurrence is almost unconceivable.

d) It is important to note that a risk assessment cannot be assumed to be always the same in each FOSA. A failure or condition considered as “major/unlikely” for an aircraft, procedure, and operational environment could be easily considered as “hazardous/remote” for another aircraft, procedure, and operational environment.

6.3 The following conditions are examples of the most significant hazards and mitigations associated to a specific aircraft, operational criterion, and RNP AR APCH operational procedures.

a) **Aircraft**.-

1) This area of the FOSA is derived from the safety analysis of aircraft systems, the documentation describing the system, and operational experience. The aspects to consider are as follows:

(a) Failure of the following systems:

- navigation;
- flight guidance;
- flight instruments for approach, missed approach or departure (for example, loss of GNSS updating, receiver failure, auto-pilot disconnect, FMS failure, etc.).

Note.- *Depending on the aircraft, this may be addressed in the aircraft design and operational procedures as cross-check guidance (e.g., dual equipment for lateral errors, use of EGPWS/TAWS).*

(b) Malfunction of altimetry or air data systems.- The risk can be mitigated through a cross-check procedure between two independent systems.

2) The FOSA must also consider normal, rare-normal, and non-normal conditions.

(a) Normal performance.- Lateral and vertical precision and RNP performance are addressed in aircraft requirements, in the aircraft itself, and in the systems normally operated in standard configurations and operating modes, while individual error components are monitored through the design system and crew procedures.

(b) Rare-normal and non-normal performance.- RNP lateral and vertical precision is assessed through system failures, as part of aircraft qualification. Additionally, other rare-normal and non-normal conditions, as well as ATC operating conditions, flight crew procedures, NAVAID infrastructure, and the operational environment are also assessed with respect to RNP or 2xRNP, as appropriate. When the results of a failure or condition are not acceptable for continued operations, mitigations must be developed or limitations established for the aircraft, flight crew and/or operation.

b) **Aircraft performance**.-

1) The RNP AR APCH procedure design criteria are linked to general aircraft performance. The result may be conservative in terms of performance margins, depending on the aircraft and the systems that have been assessed. These are the specific parameters that shall be assessed for the deviation as they relate to those in the procedure design, such as bank angle limit, climb, high altitude performance, etc.

2) *Inadequate performance to conduct the approach*.- The initial aircraft qualification and operational procedures ensure an adequate performance on each approach, as part of flight planning and to initiate or continue the approach. Consideration shall be given to aircraft configuration and any configuration change associated with a go-around (*e.g.,* engine failure, flap retraction).

3) *Loss of engine*.- Loss of an engine while conducting an RNP AR APCH procedure is a rare occurrence due to high engine reliability and the short exposure time during the approach. Operators are expected to develop flight procedures and training allowing them to take appropriate action to mitigate the effects of a loss of engine through a go-around and taking manual control of the aircraft, if necessary.

c) **Navigation services**.-

1) The use and availability of navigation services are critical in RNP AR APCH applications, where small RNP values are required for the approach and possible extraction maneuvers. Multi-sensor navigation systems must be assessed as to use and selection of sensors. The following must be considered:

(a) *Use of NAVAIDs outside of their designated coverage or in test mode*. Aircraft requirements and operational procedures have been developed to mitigate this risk.

(b) *Navigation database errors*.- Procedures must be validated through a validation flight specific to the operator and aircraft, and the operator must have a process defined to maintain validated data through navigation database updates.

Note.- *Navigation database assurance is covered by the letters of authorization issued by the CAAs to database manufacturers, which must be combined with operator procedures to ensure that the correct and updated databases are installed on the aircraft.*

d) **ATC operations**.-

1) Frequently, the ATC is not involved in the implementation of RNP AR APCH operations until it is too late. An early revision of ATC operational aspects is critical to enable RNP AR APCH procedures. In this sense, the following must be considered:

(a) Procedures assigned to an aircraft that is not RNP AR APCH capable: Operators are responsible for not accepting the authorization.

(b) The ATC provides vector guidance onto an approach whose performance cannot be achieved by the aircraft: ATC procedures and training must ensure obstacle clearance until the aircraft is established on the procedure. The aircraft shall not be guided by the ATC over or towards a point too close to the curved segments of the procedure.

e) **Flight crew operations**.-

1) Human factors in RNP AR APCH operations are related to an increased reliance on ground and air automation to reduce human error exposure and incidents. However, since human action and interaction are required, at least the following must be considered:

(a) Incorrect barometric altimeter setting: Is there a flight crew entry and check procedure to mitigate this risk?

(b) Incorrect procedure selection or loading.- Is there a flight crew procedure to verify that the loaded approach corresponds to the published procedure? Is there an on board display requirement?

(c) Incorrect flight control mode selection: Is there any training on the importance of the flight control mode, and an independent procedure to monitor an excessive path deviation?

(d) Incorrect RNP selection: Is there a flight procedure to check if the RNP loaded on the system corresponds to the published value?

(e) Go-around and missed approach: Assess the risk of a balked approach at or below the DA (H). Note that this does not respond to procedure design criteria.

(f) Unfavorable meteorological conditions: What is the risk of losing or significantly reducing visual reference that might result in, or require a go-around, and what would be the effect?

f) **Infrastructure.-**

1) Support infrastructure and services are an integral part of aircraft performance: Some aspects are already addressed in the aircraft system risk and safety analyses.

2) GNSS satellite failure: This condition is assessed during aircraft qualification to ensure that it is possible to maintain obstacle clearance, considering the low probability of failure occurrence.

3) Loss of GNSS signals: Relevant independent equipment (*e.g.,* IRU) is required for RNP AR APCH operations with RF legs and approaches where missed approach precision is less than 1 NM. Other approaches use operational procedures to approach a published track or climb over obstacles.

4) Testing of ground NAVAIDs in the vicinity of the approach: Aircraft and operational procedures are required to detect and mitigate this event.

g) **Operating conditions**.-

1) Certain aspects of the aerodrome and the airspace environment are reflected on the RNP AR APCH procedure design criteria. In this sense, the following must be considered:

(a) Tailwind conditions: Excessive speed on RF legs will result in inability to maintain the track. This must be addressed in the aircraft requirements for command guidance limits, inclusion of a banking maneuverability margin of 5 degrees, consideration of the effect of speed and flight crew procedures on maintenance of speeds below the maximum authorized speed.

(b) Crossed wind conditions and the effect of flight technical error: Consider that a nominal flight technical error is assessed under a variety of wind conditions, and that a flight crew procedure to monitor and limit deviations, ensures a reliable operation.

(c) Effects of extreme temperature on barometric altitude (*e.g.,* extreme cold temperatures, knowledge of local meteorological or atmospheric phenomena, upper winds, severe turbulence, etc.): The effect of this error on vertical path is mitigated by procedure design and flight crew procedures. Aircraft that have a temperature compensation system can conduct procedures regardless of the published temperature limit. The effect of this error on minimum altitude segments and on the decision altitude is addressed in an equivalent manner for all other approach procedures.

6.4 Repercussions on the proposed solutions/mitigations.-

a) When assessing different conditions and risks, some may fall on a range where risk or probability is not acceptable. When reviewed by the team of FOSA experts, a range of possible solutions (*e.g.,* system design, procedures, processes, etc.) may be identified, which, turned into mitigations, reduce the level of risk and/or risk incidence in such a way that risks can be considered acceptably safe for RNP AR APCH operations. The following aspects must be considered:

1) **Operations**.-

(a) What are the repercussions/changes for ATC, dispatch, maintenance, flight procedures (*e.g.,* knowledge of aircraft capability, RNP equipment prediction, equipment required, and specific checks, respectively).

2) **Safety/risk**.-

(a) How do main differences in procedure design or operational requirements associated with aircraft or operator qualification compare (*e.g.,* what aircraft or operator exceptions or limitations compare to operational or procedural requirements)?

(b) How does the certification basis apply to intended operations? For example, are the demonstrated performance (RNP), functionality, and capabilities, together with safety and risk assessments equivalent or better than that required for the operation?

(c) How are rare-normal and non-normal conditions, failures or hazards considered in the procedure design criteria, aircraft and operator qualifications, or in the added procedures or system checks?

(d) How is the safe termination of the procedure or extraction affected?

3) General applicability in RNP AR APCH operations.-

(a) RNP AR APCH procedures and operational requirements differ and, thus, an applicant must consider the effect of possible mitigations on the general use of RNP aircraft regarding crew training, procedures, equipment, ATC interfaces, etc.

(b) The different hazards considered in the FOSA must be summarized, together with the associated hazards and their frequency, mitigations, and the level of the mitigated hazard and its frequency. Significant factors and aspects shall be highlighted in the final recommendations (see the attached example in Table 9-3 – Example of a FOSA work sheet).

Note.- *While many aspects and questions in this appendix must be considered in the FOSA methodology, this material does not need to be included in the FOSA if reference is made in the package of the applicant.*

Table 9-3 – Example of a FOSA work sheet

Hazard identification	ID	Name	Severity	Likelihood	Description	Mitigation	Severity of the mitigation	Frequency of the mitigation	Ref. Doc.
Aircraft/system failure	A1	Engine failure	Significant	Remote	The engine failure can cause loss of separation from the ground.	A performance assessment has been done with a single engine to determine the specific performance conditions for ABC company. The crews must conduct the existing single-engine failure procedures.	Minor	Remote	PBN Manual Ch 5; 5.1
	A2	Failure of one GNSS receiver	Minor	Remote	The failure of one GPS receiver results in loss of navigation capability redundancy.	For RNP AR APCH procedures, two GNSS receivers are required. Flight crew procedures require a go-around upon failure of one GPS within the FAF. Crew procedures require a go-around for all failures within	Insignificant	Remote	PBN Manual Ch 5; 5.5

Hazard identification	ID	Name	Severity	Likelihood	Description	Mitigation	Severity of the mitigation	Frequency of the mitigation	Ref. Doc.
						the FAF, except under visual conditions.			
	A3	Incorrect flap retraction							
	A4	FMC/CDU dual failure under IMC conditions							
	A5	Degradation or loss of GPS signal							
	A6	Loss of all APs/ control mode							
	A7	Failure of two GNSS receivers							
	A8	AP disconnect							
	A9	Loss of equipment, resulting in single-system operation							
	A10	Air data/altimeter failure, resulting in display differences							
Operational environment (*e.g.,* physical conditions, airspace, and route design)	E1	Performance limited by tailwind							
	E2	Environmental temperature							
	E3	Strong cross-winds							
Operators	H1	Incorrect pilot response							
	H2	Poor pilot response or pilot error							

Hazard identification	ID	Name	Severity	Likelihood	Description	Mitigation	Severity of the mitigation	Frequency of the mitigation	Ref. Doc.
Human-machine interface	I1	Incorrect altimeter setting due to error in ATC-to-aircraft communications							
Operational procedures	P1	Temperature compensation							
	P2	Balked or rejected landing							
Maintenance procedure	M1	Incorrect navigation database							
External services	S1	Source-altimeter error							
	S2	ATC							
	S3	NAVAID out of coverage or in test mode							
	S4	Lack of GNSS satellite							

APPENDIX D

ADVISORY CIRCULAR

AC	**:**	**91-010**
DATE	**:**	**12/03/09**
REVIEW	**:**	**Original**
ISSUED BY	**:**	**SRVSOP**

SUBJECT: APPROVAL OF AIRCRAFT AND OPERATORS FOR APPROACH OPERATIONS WITH VERTICAL GUIDANCE/BAROMETRIC VERTICAL NAVIGATION (APV/baro-VNAV)

1. PURPOSE

This advisory circular (AC) establishes the requirements of APV/baro-VNAV (barometric vertical navigation) approach for aircraft and operators. Barometric vertical navigation may be included together with lateral navigation in a RNP ARCH approach, as established in CA 91-008. Criteria of this CA 91-010 together with criteria of CA 91-008, establishes requirements for RNP APCH approach with baro-VNAV.

This advisory circular (AC) provides acceptable means of compliance (AMC) for the approval of aircraft and operators for approach operations with vertical guidance/barometric vertical navigation (APV/baro-VNAV).

An operator may use other means of compliance, provided they are acceptable to the civil aviation administration (CAA).

Use of the future tense of the verb or the term “must” applies to an applicant or operator that chooses to meet the criteria established in this AC.

2. RELATED SECTIONS OF THE LATIN AMERICAN AERONAUTICAL REGULATIONS (LARs) OR EQUIVALENT

LAR 91: Section 91.880 (b) or equivalent
LAR 121: Section 121.995 (b) or equivalent
LAR 135: Section 135.565 (c) or equivalent

3. RELATED DOCUMENTS

Annex 6	Aircraft operations
Doc 9613	Performance based navigation manual (PBN) Attachment A – Barometric VNAV
Doc 9905 (final draft)	Required navigation performance authorization required (RNP AR) procedure design manual
Doc 8168	Aircraft operations Volume I: Flight procedures Part II, Section 4, Chapter 1 – APV/baro-VNAV approach procedures Volume II: Construction of visual and instrument flight procedures Part III, Section 3, Chapter 4 – APV/baro-VNAV

AMC 20-27	Airworthiness approval and operational criteria for RNP APPROACH (RNP APCH) operations including APV BARO-VNAV operations
FAA AC 90-105	Approval guidance for RNP operations and barometric vertical navigation in the U.S. National Airspace System

4. DEFINITIONS AND ABBREVIATIONS

4.1 Definitions

a) **Vertical path angle (VPA).-** Final approach descent angle published in the baro-VNAV procedures.

b) **Decision altitude (DA) or decision height (DH).-** A specified altitude or height in the precision approach or approach with vertical guidance at which a missed approach must be initiated if the required visual reference to continue the approach has not been established.
Note 1.- *The decision altitude (DA) is referenced to mean sea level and the decision height (DH) is referenced to the threshold elevation.*

Note 2.- *The required visual reference means that section of the visual aids or of the approach area which should have been in view for sufficient time for the pilot to have made an assessment of the aircraft position and rate of change of position, in relation to the desired flight path. In Category III operations with a decision height the required visual reference is that specified for the particular procedure and operation.*
Note 3.- *For convenience where both expressions are used they may be written in the form "decision altitude/height" and abbreviated "DA/H".*

c) **Reference datum height (RDH).-** Height of the extended glide path or of the nominal vertical path at the runway threshold.

d) **Primary field of view.-** For purposes of this AC, the primary field of view is within 15 degrees of the primary line of sight of the pilot.

e) **Approach procedure with vertical guidance (APV).-** Instrument procedure in which lateral and vertical guidance is used, but which does not meet the requirements established for precision approach and landing operations.

f) **Non-precision approach procedure (NPA).-** Instrument approach procedure in which lateral but not vertical guidance is used.

g) **Precision approach procedure (PA)**.- An instrument approach procedure using precision lateral and vertical guidance with minima as determined by the category of operation.
Note.- *Lateral and vertical guidance refers to the guidance provided either by:*
a) a ground-based navigation aid; or
b) computer-generated navigation data.

h) **Way-point (WPT).** A specified geographical location used to define an area navigation route or the flight path of an aircraft employing area navigation. Way-points are identified as either:

Fly-by way-point (fly-by WPT). A way-point which requires turn anticipation to allow tangential interception of the next segment of a route or procedure, or
Flyover way-point (flyover WPT). A way-point at which a turn is initiated in order to join the next segment of a route or procedure.

i) **Initial approach fix (IAF).-** Fix that marks the beginning of the initial segment and the end of the arrival segment, if applicable. In RNAV application, this fix is normally defined as a "fly-by fix".

j) **Flight management system (FMS).-** Integrated system made up by an on-board sensor, a receiver, and a computer with navigation and aircraft performance databases, capable of providing performance values and RNAV guidance to a display and automatic flight control system.

k) **RNAV system**.- Area navigation system that allows the aircraft to operate on any desired flight path within the coverage of ground- or airspace-based navigation aids or within the capacity limits of autonomous aids or a combination of both. An RNAV system may be included as part of a flight management system (FMS).

l) **RNP system**.- Area navigation system that provides on-board performance control and alert.

m) **Vertical navigation**.- A navigation method that allows the aircraft to operate on a vertical flight profile using altimetry sources, external flight path references, or a combination of these.

n) **Barometric vertical navigation (baro-VNAV).- A navigation system that presents the pilot** with a calculated vertical guidance taking as a reference a specified vertical path angle (VPA), nominally 3. The computer-estimated vertical guidance is based on the barometric altitude and is specified as a VPA from the reference datum height (RDH).

4.2 Abbreviations

a)	AAC	Civil Aviation Administration
b)	AC	Advisory circular (FAA)
c)	AFM	Aircraft flight manual
d)	AIM	Aeronautical information manual
e)	AMC	Acceptable means of compliance
f)	AP	Autopilot
g)	APCH	Approach
h)	APV	Approach procedure with vertical guidance
i)	APV/baro-VNAV	Approach procedure with vertical guidance/Barometric vertical navigation
j)	AR	Authorization required
k)	ARINC	*Aeronautical radio, Incorporated*
l)	ASE	Altimetry system error
m)	ATC	Air traffic control
n)	baro-VNAV	Barometric vertical navigation
o)	AC	Advisory circular (SRVSOP)
p)	CFIT	Controlled flight into terrain
q)	CFR	US Code of Federal Regulations

r)	CS	Certification specifications (EASA)
s)	DA/H	Decision altitude/height
t)	DME	Distance measuring equipment
u)	EASA	European Aviation Safety Agency
v)	EHSI	Enhanced horizontal situation indicator
w)	FAA	US Federal Aviation Administration
x)	FAF	Final approach fix
y)	FAP	Final approach point
z)	FD	Flight director
aa)	FMS	Flight management system
bb)	FTD	Flight training devices
cc)	FTE	Flight technical error
dd)	GNSS	Global navigation satellite system
ee)	Hg	Inches of mercury
ff)	hPa	Hectopascals
gg)	HSI	Horizontal situation indicator
hh)	IAF	Initial approach fix
ii)	IRU	Inertial reference unit
jj)	ISA	International standard atmosphere
kk)	KIAS	Indicated airspeed
ll)	LAR	Latin American Aeronautical Regulations
mm)	LNAV	Lateral navigation
nn)	LNAV MDA	Lateral navigation minimum descent altitude
oo)	LOA	Letter of authorization/acceptance
pp)	MAPt	Missed approach point
qq)	MDA/MDH	Minimum descent altitude/height
rr)	MEL	Minimum equipment list
ss)	NPA	Non precision approach procedure
tt)	ICAO	International Civil Aviation Organization
uu)	OCA/H	Obstacle clearance altitude/height
vv)	OM	Operations Manual
ww)	PANS-OPS	Procedures for air navigation services - Aircraft operations
xx)	PBN	Performance-base navigation
yy)	PA	Precision approach procedure
zz)	PDE	Path definition error
aaa)	PF	Pilot flying
bbb)	PM	Pilot monitoring
ccc)	QNE	Standard atmosphere that corresponds to 1013 hPa or 29.92” Hg. This setting indicates the altitude above the isobaric surface of 1013 hPa, if temperature is standard
ddd)	QNH	Pressure at mean sea level. This setting indicates the altitude above the means sea level (MSL), if temperature is standard.
eee)	RDH	Reference datum height
fff)	RNAV	Area navigation
ggg)	RNP	Required navigation performance
hhh)	RNP APCH	Required navigation performance approach
iii)	RNP AR APCH	Required navigation performance approach with authorization required
jjj)	SBAS	Satellite-based augmentation system
kkk)	TCH	Obstacle clearance height

lll)	TSO	Standard technical order
mmm)	VDI	Vertical deviation indicator
nnn)	VNAV	Vertical navigation
ooo)	VNAV DA	Vertical navigation decision altitude
ppp)	VPA	Vertical path angle
qqq)	WPT	Waypoint

j) INTRODUCTION

5.1 The acceptable means of compliance of this AC are based on the use of barometric vertical navigation (baro-VNAV).

5.2 The baro-VNAV navigation system presents the pilot with estimated vertical guidance referenced to a specified vertical path angle (VPA), nominally of 3º. The computed vertical guide is based on the barometric altitude and is specified as a VPA from the reference datum height (RDH).

5.3 The calculated vertical path is stored in the instrument flight procedure specification in the database of the area navigation (RNAV) system or of the required navigation performance (RNP) system.

5.4 For other flight phases, barometric VNAV offers vertical guidance path information that can be defined by vertical angles or altitudes at the procedure fixes.

5.5 It should be noted that there is no vertical requirement in this AC associated with the use of vertical guidance outside of the final approach segment. Therefore, vertical navigation can be performed without VNAV guidance in the initial and intermediate segments of an instrument procedure.

5.6 Aircraft authorised to conduct RNP approach operations requiring authorization (RNP AR APCH) are considered eligible for the baro-VNAV operations described in this AC. In this sense, there is no need for a new approval according to the criteria established in this document.

5.7 The procedures to be established pursuant to this AC will permit the use of high-quality vertical navigation capabilities that will improve safety and reduce the risks of controlled flight into terrain (CFIT).

5.8 The material described in this AC is derived from the following documents:

- ✓ Attachment A – Volume II, ICAO Doc 9613; and
- ✓ Chapter 1 – APV/baro-VNAV Approach Procedures, Section 4, Part II, Volume I – Flight procedures, of ICAO Doc 8168 d– Aircraft operations (PANS-OPS).

5.9 Inasmuch as possible, this AC has been harmonised with:

- ✓ AMC 20-27 of the European Aviation Safety Agency (EASA) - Airworthiness approval and operational criteria for RNP APPROACH (RNP APCH) operations including APV BARO-VNAV operations; and
- ✓ AC 90-105 of the United States Federal Aviation Administration (FAA) - Approval guidance for RNP operations and barometric vertical navigation in the U.S. National Airspace System.

Note.- *Notwithstanding harmonisation efforts, operators shall note the differences that exist between this AC and the aforementioned documents when applying for an authorization from the corresponding Administrations.*

k) DESCRIPTION OF THE NAVIGATION SYSTEM

6.1 **Vertical navigation (VNAV)**.-

a) In VNAV, the system allows the aircraft to fly level and to descent point to point in a vertical linear path that is kept in the aircraft navigation database. The vertical profile will be based on altitude limitations or VPAs, where appropriate, associated with the waypoints (WPTs) of the vertical navigation path.

Note.- *Normally, VNAV is a mode of flight guidance systems, where the RNP equipment containing the VNAV capability has commands to provide path guidance to the flight guidance system, which controls the flight technical error (FTE) by means of the pilot manual control in the vertical deviation display or through flight director (FD) or autopilot (AP) coupling.*

l) **CLASSIFICATION OF APV/BARO VNAV APPROACH PROCEDURES**

7.1 Vertical guidance/barometric vertical navigation (APV/baro-VNAV) approach procedures are classified as instrument approach procedures for approach and landing operations with vertical guidance (see the definition in Annex 6, Part I, to the Chicago Convention). These procedures are published with a decision altitude/height (DA/H) and must not be confused with non-precision procedures (NPA), where a minimum descent altitude/height (MDA/H) below which the aircraft must not descend is specified.

7.2 The use of APV/baro-VNAV procedures improves the safety of NPA procedures, providing a guided and stabilised descent for landing, thus avoiding an early descent to minimum altitudes.

7.3 Notwithstanding the above, the inherent inaccuracy of barometric altimeters and the certified performance of the specific RNAV mode used, prevent the systems of these procedures from emulating the accuracy of the systems used in a precision approach (PA). In particular, with some systems it might not be possible to keep the aircraft within the obstacle-free surfaces of Annex 14 to the Chicago Convention. Thus, the pilot must keep this possibility in mind when making the decision to land at the decision altitude/height (DA/H).

7.4 In APV/baro-VNAV approach procedures no final approach fix (FAF) or missed approach fix (MAPt) is identified.

7.5 The lateral part of APV/baro-VNAV criteria is based on non-precision RNAV criteria. However, the FAF is not part of the APV/baro-VNAV procedure and is replaced by a final approach point (FAP), although the RNAV FAF may be used as a final approach course fix when designing the database. Likewise, the MAPt is replaced by a DA/H, which depends upon the category of the aircraft.

7.6 The LNAV FAF and MAPt are used for coding purposes in the baro-VNAV procedure and are not aimed at inhibiting the descent in the FAP or restricting the DA/H.

7.7 The minimum DH for APV/baro-VNAV is 75 m (246 ft) plus the height loss margin. However, the operator may increase this minimum DH limit to at least 90 m (295 ft) plus a height loss margin, when the lateral navigation system is not certified to ensure that the aircraft will be within the inner approach surfaces, inner transitional surfaces, and balked landing surface indicated in Annex 14 to the Chicago Convention (with the necessary extension above the inner horizontal surface, up to the obstacle clearance altitude/height (OCA/H)) with a high degree of probability.

m) **AIRCRAFT EQUIPMENT REQUIREMENTS**

8.1 APV/baro-VNAV procedures are to be used by aircraft equipped with flight management systems (FMS) or other RNAV or RNP systems capable of calculating barometric VNAV paths and, based on these, display deviations on the instrument visual indicator.

8.2 Aircraft equipped with APV/baro-VNAV systems that have been approved by the State of Registry for the corresponding level of lateral navigation operations (LNAV)/VNAV may use these systems to conduct APV/baro-VNAV approaches, provided:

a) the navigation system has a certified performance of 0,3 NM or lower, with a 95% probability. This includes:
   1) global navigation satellite systems (GNSS) certified for approach operations;
   2) multiple-sensor systems that use inertial reference units (IRU) in combination with dual distance measuring equipment (DME/DME) or certified GNSS systems; and
   3) RNP systems approved for operations with RNP 0,3 or lower.

b) the APV/baro-VNAV equipment is operational;

c) the aircraft and the aircraft systems are properly certified for the planned APV/baro-VNAV approach operations;

d) the aircraft is equipped with an integrated LNAV/VNAV system with an accurate source of barometric altitude; and

e) VNAV altitudes and all the relevant procedural and navigation information are obtained from a navigation database whose integrity is supported by appropriate quality assurance measures.

8.3 In cases where LNAV/baro-VNAV procedures have been published, the approach area will be assessed in order to identify obstacles invading the inner approach surfaces, the inner transitional surfaces, and the balked landing surface defined of Annex 14 to the Chicago Convention. If obstacles invade these surfaces, a restriction amounting to the minimum value of the allowed OCA/H will be imposed.

8.4 APV/baro-VNAV operations are based on RNAV/RNP systems that receive inputs from equipment that may include:

a) an air data computer: FAA Technical Standard Order (TSO)-C 106.

b) an air data system: Aeronautical Radio, Incorporated (ARINC) 706, Mark 5 Air Data System.

c) a barometric altimetry system of the following types: DO-88 altimetry, ED-26 MPS for airborne altitude measurements and coding systems, ARP-942 pressure altimeter systems, ARP-920 design and installation of pitot static systems for transport aircraft.

d) integrated type-certified systems providing the capabilities of an air data system comparable to the one described in paragraph b).

Note 1.- *Position data from other sources may be integrated with the barometric altitude information, provided they do not cause position errors exceeding the path-keeping precision requirements.*
Note 2.- *The altimetry system performance will be demonstrated separately through the certification of static pressure systems (e.g., *14 CFR 25.1325 or *CS 25.1325 or equivalent sections, where performance must be 30 ft by 100 knots of indicated airspeed (KIAS). Altimetry systems that meet this requirement will meet the altimetry system error (ASE) requirements for baro-VNAV operations. Additional compliance or demonstration is not required.*
**14 CFR 25.1325: Section 1325 of Part 25 of Title 14 of the United States Code of Federal Regulations (CFR).*
**CS 25.1325: Certification Specification (CS) 25.1325 of EASA certification specifications for large aircraft (CS 25).*

8.5 Functional continuity.- At least one RNAV system is required to conduct baro-VNAV operations.

n) **SYSTEM PRECISION**

9.1 For instrument approach operations, it must be demonstrated that the on board VNAV equipment error, excluding altimetry, is lower than the values described in Table 9-1, with a probability of 99.7%.

Table 9-1

	Level flight segments and altitude interception region of climbs/descents at specific altitudes (ft)	Climbs/descents along the specified vertical profile (angle) (ft)
At or above 5 000 ft	50	100
5 000 ft to 10 000 ft	50	150
Above 10 000 ft	50	220

Note.- *The VNAV equipment error is the error associated with the calculation of the vertical path. This includes the path definition error (PDE) and an approach performed by the VNAV equipment from the construction of the vertical path, if any.*

9.2 Vertical flight technical errors (FTE).- Using satisfactory displays of vertical guidance information, it must be demonstrated that the flight technical errors are below the values shown in Table 9-2, based on three sigmas:

Table 9-2

	Level flight segments and climb/descent altitude interception region at specific altitudes (ft)	Climbs/descents along the specified vertical profile (angle) (ft)
At or above 5 000 ft	150	200
5 000 ft to 10 000 ft	240	300
Above 10 000 ft	240	300

9.3 Regarding the facility, a sufficient number of test flights should be conducted to verify that these values could be maintained. Lower FTE values can be achieved, especially when the VNAV system is coupled to an AP or FD. However, at least the total system vertical precision shown in Table 9-3 must be maintained.

9.4 If a facility produces higher FTEs, the total vertical error of the system (excluding altimetry) can be determined by combining the FTEs with the equipment errors using the root sum square method. The result shall be lower than the values listed in Table 9-3:

Table 9-3

	Level flight segments and the climb/descent interception region at specific altitudes (ft)	Climbs/descents along the specified vertical profile (angle) (ft)
At or above 5 000 ft	158	224
5 000 ft to 10 000 ft	245	335
Above 10 000 ft	245	372

9.5 The approval of the VNAV system, in keeping with FAA AC 20-129, and the approval of the

altimetry system in keeping with FAR/CS/LAR 25.1325 or equivalent, constitute acceptable means of compliance with the aforementioned precision requirements.

o) **APV/baro-VNAV FUNCTIONAL REQUIREMENTS**

10.1 **Required functions.-**

a) **Displays**.- APV/baro-VNAV deviations must be shown on a vertical deviation display (*e.g.,* the horizontal situation indicator (HSI), the enhanced horizontal situation indicator (EHSI), and the vertical deviation indicator (VDI)).
This display must be used as primary flight instrument during the approach. The display must be visible to the pilot and be located in the primary field of vision of the pilot.
The deviation display must have an appropriate total scale deflection based on the required vertical track error.

b) **Continuous deviation display**.- The navigation display must provide the capacity of continuously showing the aircraft position relative to the defined vertical path to the pilot flying the aircraft (PF), on the primary navigation flight instruments. The display must permit the pilot to readily note if the vertical deviation exceeds +100/-50 ft. The deviation shall be monitored and the pilot will take the appropriate action to minimise errors.
Note.- *When the minimum crew consists of two pilots, a means shall be provided for the pilot not flying the aircraft (pilot monitoring (PM)) to check the desired path and the aircraft position relative to the path.*

1) It is recommended that a properly graduated non-numerical deviation display (*e.g.,* the vertical deviation indicator) be located on the primary field of vision of the pilot. A fixed-scale deviation indicator is acceptable, provided said indicator demonstrates the proper setting and sensitivity for the planned operation. Alert and annunciation limits must also correspond to scale values.
Note.- *Current systems incorporate vertical deviation scales in the range of ± 500 ft. These deviation scales shall be assessed based on the aforementioned requirements.*
2) Instead of duly graduated vertical deviation indicators, it may be acceptable to have a numerical vertical deviation display, depending on the flight crew workload and display characteristics. The use of a numerical display may require initial and recurrent training for the flight crew.
3) Since the vertical deviation scale and sensitivity vary significantly, an eligible aircraft may also be equipped with an operational FD or AP capable of following a vertical path.

c) **Definition of the vertical path**.- The navigation system must be capable of defining a vertical path in keeping with the published vertical path. It must also be capable of specifying a vertical path within the altitude limitations of two fixes in the flight plan. Altitude limitations at fixes must be defined as either:
1) an AT or ABOVE altitude limitation (for example, 2400A may be appropriate when there is no need to limit the vertical path);
2) an AT or BELOW altitude limitation (for example, 4800B may be appropriate when there is a need to limit the vertical path);
3) an AT altitude limitation (for example, 5200); or
4) a WINDOW-type altitude limitation (for example, 2400A3400B).

Note.- *For RNP AR APCH procedures, any segment with a published path will define that path based on an angle to the fix and altitude.*

d) **Path construction**.- The system must be capable of constructing a path to provide vertical guidance from a current position to a limited fix.

e) **Capacity to load procedures from the navigation database**.- The navigation system must be capable of loading and modifying, within the RNAV/RNP system, a complete procedure or procedures from the aircraft database. This includes the approach (with a vertical angle), the missed approach, and the approach transitions to the aerodrome and selected runway. The RNAV/RNP system shall prevent the modification of the procedure information contained in the navigation database.

f) **User interface (control and displays)**.- the output reading and input resolution of the information shall be as follows:

Parameters		Display resolution	Input resolution
Altitude	Above the transition level altitude	Flight level	Flight level
	Below the transition level altitude	1 ft	1 ft
Vertical path deviation		10 ft	Not applicable
Flight path angle		0.1º	0.1º
Temperature		1º	1º

g) The navigation database must contain the necessary information to fly the APV/baro-VNAV approach. This database must contain the WPTs and associated vertical information (obstacle clearance height (TCH) and flight path angle (VPA)) for the procedure.
Vertical limitations (altitudes and airspeeds) associated with published procedures must be automatically retrieved from the navigation database once the approach procedure has been selected.

h) The navigation system must be capable of indicating the navigation loss (*e.g.,* loss of the system) on the primary field of vision of the pilot through a precaution signal (flag) or equivalent indicator on the vertical navigation display.

i) The aircraft must show barometric altitude from two independent altimetry sources, one on each primary field of vision of each pilot. When single-pilot operation is permitted, the two displays must be visible from the pilot position.

10.2 **Recommended functions**.-

a) **Temperature compensation** The baro-VNAV navigation system should be capable of automatically adjusting the vertical flight path for temperature effects. The equipment should give access to the altimetry temperature source in order to calculate temperature compensation for the vertical flight path angle. The system should give clear and identifiable indication of compensation and setting to the flight crew.

b) Capability of automatically intercepting the vertical path at the final approach point (FAP), using the vertical fly-by technique.

p) **TEMPERATURE LIMITATIONS**

a) For aircraft using barometric vertical navigation without temperature compensation on approach, low temperature limitations are reflected on the procedure design and identified on the procedure chart, together with any high temperature limit. Low temperatures reduce the actual glide path angle, while high temperatures increase the glide path angle. Aircraft using barometric vertical navigation with temperature compensation or aircraft using an alternate means of vertical guidance (*e.g.*, satellite-based augmentation system (SBAS)) can get around temperature limitations.

b) Since the temperature limits established in the charts are only assessed for obstacle clearance in the final approach segment, and since temperature compensation only affects vertical guidance, the pilot may need to adjust the minimum altitude on the initial and intermediate approach segments, and at the decision altitude/height (DA/H)).

Note 1.- *Temperature affects the indicated altitude. The effect is similar to having high and low pressure changes, but not as significant as such changes. When the temperature is higher than standard (temperature under international standard atmospheric (ISA) conditions)), the aircraft will be flying above the indicated altitude. When the temperature is below the standard, the aircraft will be flying below the altitude indicated in the altimeter. For further information, refer to altimetry errors in the aeronautical information manual (AIM)*

Note 2.- *The ISA standard conditions at sea level are:*

- *The standard temperature is defined as 15º Celsius (centigrades) or 288.15º Kelvin;*
- *The standard pressure is defined as 29.92126 inches of mercury (Hg) or 1013.2 hectopascals (hPa); and*
- *The standard density for these conditions is 1.225 kg/m^3 or 0.002377 slugs/cubic ft.*

q) **OPERATIONAL PROCEDURES**

12.1 For APV/baro-VNAV operations, the crews must be familiar with the following procedures:

a) **Corrections for low temperatures**.- Pilots are responsible for any low temperature correction required at all minimum altitudes/heights published. This includes:

a) The altitudes/heights for initial and intermediate segments;
b) The DA/H; and
c) Subsequent missed approach altitudes/heights.

Note.- The VPA of the final approach path is protected against the effects of low temperatures by the procedure design.

b) **Altimeter setting**.- APV/baro-VNAV operations will only be conducted when:

1) a current and local source for altimeter setting is available; and
2) the *QNH/*QFE is properly selected in the aircraft altimeter.

*QNH: Pressure at mean sea level. This setting indicates the altitude above mean sea level, (MSL) with standard temperature.

*QFE: Standard atmosphere that corresponds to 1013 hPa or 29.92" Hg. This setting indicates the altitude above the isobaric surface of 1013 hPa, with standard temperature.

Note.- *a remote source for altimetry setting shall not be used.*

c) **Actions to be taken at the DA**.- The flight crew is expected to operate the aircraft along the

published vertical path, and to execute a missed approach procedure once it reaches the DA, unless the required visual references to continue with the approach are on sight.

d) **Temperature limitation**.- Due to the pronounced non-standard temperature effects on baro-VNAV operations, instrument approach procedures will contain a temperature limitation below which the use of a vertical navigation decision altitude (VNAV DA) based on baro-VNAV is not authorised. The temperature limitation will be shown through a Note in the instrument approach procedure. If the aircraft system is capable of temperature compensation, the crew must follow the operator procedures based on the manufacturer instructions.

e) **Selection of the VNAV path mode**.- The flight crew must know the correct selection of the vertical mode(s) commanding vertical navigation through the published flight path. Other vertical modes, such as vertical speed, do not apply to baro-VNAV approaches.

f) **Restriction to using a remote source for altimeter setting**.- The use of baro-VNAV up to a DA is not authorised if the altimeter setting is issued from a remote source. For APV/baro-VNAV operations, a current altimetry setting is required for the landing aerodrome. When minima related to a remote altimetry setting are shown, the VNAV function can be used, but only up to the published lateral navigation minimum descent altitude (LNAV MDA).

g) **Manual adjustments**.- If manual adjustments are necessary for storing altitude information, *e.g.*, low temperature adjustments, the flight crew must make the appropriate adjustments at the procedure altitudes and revert to the LNAV MDA of the adjusted temperature.

r) **TRAINING PROGRAMME**

13.1 The training programme of the operator shall include sufficient training on aircraft VNAV capabilities for flight crews and flight dispatchers (*e.g.*, ground training, flight simulators, flight training devices (FTD) or on board the aircraft). Training will cover the following areas:

a) information about this AC;

b) the meaning and proper use of aircraft systems;

c) the characteristics of APV/baro-VNAV procedures, as determined in the graphical chart representation and in the written description;

1) description of WPT types (fly-by and flyover WPTs), path terminators, and any other type of terminator used by the operator, as well as the associated flight paths of the aircraft;

2) information about the specific RNAV/RNP system;

3) automation levels, annunciation modes, changes, alerts, interactions, reversals, and degradation;

4) functional integration with other aircraft systems;

5) the meaning of vertical path discontinuities and related flight crew procedures;

6) monitoring procedures for each flight phase (*e.g.*, monitoring of “PROGRESS” o “LEGS”

pages);

7) turn anticipations, taking into account the effect of airspeed and altitude; and

8) interpretation of electronic displays and symbols.

d) operating procedures of VNAV equipment, where applicable, including how to do the following:

1) compliance with airspeed and/or altitude limitations associated to an approach procedure;
2) verification of WPTs and flight plan programming;
3) direct flight to a WPT;
4) determination of vertical track error/deviation;
5) insertion and deletion of the route discontinuity;
6) changing the destination and alternate aerodromes;
7) contingency procedures following VNAV failure;

e) operation of barometric altimeters.- Barometric altimeters are calibrated to indicate the true altitude under ISA atmospheric conditions. If, in a given day, the temperature is higher than ISA, the true altitude will be greater than the indicated altitude. On the contrary, on a day that is cooler than ISA, the true altitude will be lower than the indicated altitude. These errors increase in magnitude as the altitude increases over the altimetry setting source.

f) altimetry setting procedures and low temperatures.
1) Altimeter setting.- Flight crews must be cautious when changing the altimeter setting and will request a valid setting if the previous one is not valid, especially when pressure tends to drop quickly. Remote altimeter setting is not permitted for APV/baro-VNAV operations.
2) Low temperatures.- In case of low temperatures, the pilot shall verify the instrument approach procedure chart to determine the temperature limit for using the baro-VNAV capability. If the aircraft system has temperature compensation capability, the crew shall follow the procedures established by the operator based on the manufacturer instructions for using the baro-VNAV function.

g) Knowledge of failures and reversal modes.- The flight crew shall have knowledge of failures and reversal modes that hinder the capacity of the aircraft to conduct APV/baro-VNAV approaches. The flight crew must also be aware of contingency procedures (*e.g.*, reversal to LNAV MDA following a VNAV failure).

h) Operational verification of altimeters.- When two pilots are required on an aircraft, the flight crew must make sure that the two altimeters coincide within $\pm$ 100 ft prior to the FAF. If the altimeter cross-check fails, the instrument approach procedure must not be executed, or, if said procedure is in progress, it must be discontinued. If the avionics system provides an annunciation system that compares the pilot altimeters, flight crew procedures shall indicate the action to be taken in the event of a warning from the pilot altimeter comparator when executing an APV/baro-VNAV operation.

Note.- *This operational verification of the altimeters is not necessary if the aircraft automatically compares altitudes within 100 ft.*

s) **DATABASE**

a) The operator must obtain the navigation databases from a qualified provider.

b) Navigation data providers must have a letter of acceptance (LOA) in order to process the navigation information (*e.g.,* FAA AC 20-153 or document on the conditions for the issuance of letters of acceptance for navigation data providers by the European Aviation Safety Agency – EASA (EASA IR 21 Sub-part G) or equivalent documents). An LOA acknowledges the data of a provider as those in which information quality, integrity, and quality management practices are consistent with the criteria of document DO-200A/ED-76. An operator provider (*e.g.,* an FMS company) must have an LOA Type 2 and its respective providers must have an LOA Type 1 or 2.

c) The operator must report to the navigation data provider any discrepancy that invalidates a procedure, and prohibit the use of the affected procedures by means of a notice to flight crews.

d) Operators should consider the need to periodically verify the navigation databases, in order to maintain the existing requirements of the quality system or safety management system.

t) **AIRWORTHINESS AND OPERATIONAL APPROVAL**

15.1 In order to get an APV/baro-VNAV authorisation, a commercial air transport operator shall obtain two types of approval:

a) an airworthiness approval from the State of Registry; (see Article 31 of the Chicago Convention and paragraphs 5.2.3 and 8.1.1 of Annex 6, Part I); and

b) the operational approval from the State of the Operator (see paragraph 4.2.1 and Attachment F to Annex 6, Part I).

15.2 For general aviation operators, the State of Registry will determine if the aircraft meets the applicable APV/baro-VNAV requirements (see paragraph 2.5.2.2 of Annex 6, Part II).

u) **AIRWORTHINESS APPROVAL**

16.1 Aircraft eligibility

a) **RNP system capability.-** An aircraft is eligible when it meets the RNP performance and functional requirements described in SRVSOP AC 91-008 and AC 91-009 or equivalent.

b) **VNAV barometric capability.-** An aircraft is eligible when it has a flight manual (AFM) or AFM supplement clearly establishing that the VNAV system is approved for approach operations in keeping with FAA AC 20-129 or AC 20-138. Furthermore, for a VNAV system to be approved for approach operations according to AC 20-129 or AC 20-138, it must have a vertical deviation indicator (VDI). Since VDI sensitivity and setting vary significantly, an eligible aircraft must also be equipped and use either a flight director (FD) of an autopilot (AP) capable of following the vertical path. A deviation of +100/-50 ft by the pilot is considered acceptable on a published VNAV path.
Note.- *An aircraft with RNP AR APCH authorisation will be considered eligible for conducting*

baro-VNAV operations in keeping with this AC.

c) **Database requirements.-** The aircraft database must include the WPTs and the associated VNAV information, *e.g.,* altitudes and vertical angles for the procedure to be flown.

16.2 Aircraft approval

a) **Eligibility based on the AFM or AFM supplement**

1) **LAR 91 operators.-**
LAR 91 operators must review the aircraft AFM or AFM supplement in order to establish the eligibility of the navigation system as described in paragraph 16.1.

2) **LAR 121 y 135 operators.-**
(a) LAR 121 and 135 operators must present the following documentation to the CAA:
(1) the sections of the AFM or AFM supplement that document the RNAV/RNP airworthiness approval for APV/baro-VNAV approach procedures in keeping with paragraph 16.1 of this AC.

b) **Eligibility that is not based on the AFM or AFM supplement**

1) An operator may not be in a position to determine the eligibility of the equipment for conducting APV/baro-VNAV approaches based on the AFM or AFM supplement. In this case, both LAR 91 and LAR 121 and 135 operators must ask the CAA to have the Airworthiness Inspection Division or equivalent do an assessment of the baro-VNAV equipment to determine its eligibility.
2) Together with the request, the operator will provide the Airworthiness Inspection Division or equivalent the following information:
(a) name of the manufacturer, model, and part number of the RNP system;
(b) any evidence of IFR approval of the navigation system; and
(c) relevant information about flight crew operating procedures.
3) If the Airworthiness Inspection Division or equivalent is not in a position of determining the eligibility of the equipment, it shall send the request, together with the supporting data, to the Aircraft Certification Division or equivalent.
4) The Aircraft Certification Division or equivalent will verify that the aircraft and the RNAV/RNP system meet the baro-VNAV criteria and that the system can safely fly VNAV paths associated to instrument approach procedures, applying a DA instead of an MDA. The Aircraft Certification Division or equivalent will provide written documentation (*e.g.,* a report of an amended flight standard bulletin or other official document) to verify the eligibility of the equipment.
5) **For LAR 91 operators**.- If the CAA determines that the navigation equipment is eligible for baro-VNAV instrument approach operations, the Airworthiness Inspection Division or equivalent will provide documentation showing that the aircraft equipment is approved for said operations.
6) **For LAR 121 and 135 operators**.- The CAA will try to establish the eligibility of the system and will make sure that training and operation manuals reflect the operational policies of Sections 12 and 13 of this AC.
7) Compliance with airworthiness or equipment installation requirements, by itself, does not constitute operational approval.

16.3 Aircraft modification.-

a) If any system required for baro-VNAV operations is modified (*e.g.,* change in the software or hardware), the aircraft modification must be approved.

b) The operator must obtain a new operational approval that is supported by operational and aircraft qualification documentation presented by the operator.

17. OPERATIONAL APPROVAL

17.1 To obtain the operational approval, the operator will take the following steps:

a) *Airworthiness approval*.- aircraft shall have the corresponding airworthiness approvals as established in Section 16.

b) *Application*.- The operator will submit the following documentation to the CAA:

1) *the APV/baro-VNAV operational approval application*;
2) *aircraft qualification documentation*.- Documentation showing that the equipment of the proposed aircraft meets the requirements of this AC, as described in Section 16.
3) *Type of aircraft and description of the aircraft equipment to be used*.- The operator will provide a configuration list describing in detail the relevant components and the equipment to be used in the APV/baro-VNAV operation. The list shall include each manufacturer, model and version of the FMS software installed.
***Note**.- Barometric altimetry and the associated equipment, such as air data systems, are basic capabilities required for flight operations.*
4) *Operational procedures*.- Operator manuals shall properly indicate the navigation procedures identified in Section 12 of this AC. LAR 91 operators shall confirm that they will operate applying identified practices and procedures.
5) *Training programmes*.- LAR 121 and 135 operators will submit the training curricula describing the operational and maintenance procedures and training aspects related to VNAV approach operations (*e.g.,* initial, promotional, and recurrent training for flight crews, flight dispatchers, and maintenance personnel).
***Note.-** A separate training programme is not required if RNAV and VNAV training is already part of the training programme of the operator. However, it should be possible to identify the practices and procedures concerning VNAV aspects covered in the training programme. LAR 91 operators should be familiar with the practices and procedures identified in Section 13 of this AC.*
6) *Operations manual (OM) and checklists*.- Operators will submit the operations manuals and checklists containing information and guidance on APV/baro-VNAV operations.

7) *Maintenance procedures*.- The operator will submit the maintenance procedures containing airworthiness and maintenance instructions concerning the systems and equipment to be used in the operation. The operator will provide a procedure to remove and restore the APV/baro-VNAV operational capacity of the aircraft.
8) *MEL*.- The operator will submit any revision to the MEL needed to conduct APV/baro-VNAV operations.
9) *Validation*.- The CAA will determine the need to conduct validation tests based on the type of operation and operator experience. If validation tests are necessary, the operator will submit a validation test plan to show its capacity to conduct the proposed operation (see Chapter 13 of Volume II, Part II of the SRVSOP Operations Inspector Manual). The validation plan must at least include the following:
   (a) a statement indicating that the validation plan has been designated to demonstrate the capacity of the aircraft to execute APV/baro-VNAV procedures;
   (b) operational and dispatch procedures; and
   (c) MEL procedures.

   Note 1.- *the validation plan shall make use of ground training devices, flight simulators, and aircraft demonstrations. If the validation is done on board an aircraft, it must be conducted during the day and under VMC.*

   Note 2.- *validations may be required for each manufacturer, model, and version of the installed FMS software.*
10) *Conditions or limitations necessary or required for the authorisations*.- The operator will submit any condition or limitation that is necessary or required for the authorisations.

c) *Training*.- Once the CAA has accepted or approved the amendments to the manuals, programmes and documents submitted, the operator will provide the respective training to its personnel.

d) *Validation flights*.- Validation flights, if required, will be conducted according to paragraph b) 9) above.

Issuance of the authorisation.- Once all the aforementioned steps have been completed satisfactorily, the CAA will issue the OpSpecs for LAR 121 and 135 operators, or a LOA for LAR 91.

APPENDIX 1

NAVIGATION DATA VALIDATION PROGRAMME

1. INTRODUCTION

The procedure stored in the navigation database defines the aircraft lateral and vertical guidance. The navigation database is updated every 28 days. The navigation data used in each update are critical for the integrity of each APV/baro-VNAV approach. Taking into account the reduced obstacle clearance associated with these approaches, navigation data validation requires special consideration. This appendix provides guidance on the operator procedures to validate the navigation data associated with APV/baro-VNAV approaches.

2. DATA PROCESSING

a) In its procedures, the operator will identify the person responsible for updating the navigation data.
b) The operator will document a process for accepting, verifying, and loading the navigation data into the aircraft.
c) The operator must place its documented data process under configuration control.

3. INITIAL DATA VALIDATION

3.1 The operator must validate each APV/baro-VNAV procedure before flying the procedure under instrument flight meteorological conditions (IMC) to ensure compatibility with its aircraft and that the resulting paths correspond to the published procedure. As a minimum, the operator must:

a) compare the navigation data of the procedure to be loaded on the FMS with a published procedure.
b) validate the navigation data of the loaded procedure, either in the flight simulator or in the aircraft under visual flight meteorological conditions (VMC). The procedure outlined in a map display must be compared to the published procedure. The complete procedure must be flown to make sure that the path can be used, that it has no apparent lateral or vertical path disconnections, and is consistent with the published procedure.
c) once the procedure has been validated, a copy of the validated navigation data must be kept and maintained to be compared with subsequent data updates.

4. DATA UPDATING

Whenever the operator receives a navigation data update and before using such data on the aircraft, the update must be compared with the validated procedure. This comparison must identify and resolve any discrepancy in the navigation data. If there are any significant changes (any change affecting the approach path or performance) to any part of the procedure, or if such changes are verified through initial information data, the operator must validate the amended procedure based on the initial data validation.

5. NAVIGATION DATA PROVIDERS

Navigation data providers must have a letter of acceptance (LOA) to process these data (*e.g.*, FAA AC 20-153 or the document on the conditions for the issuance of letters of acceptance for navigation data providers by the European Aviation Safety Agency – EASA (EASA IR 21 Sub-part G) or equivalent

document). An LOA acknowledges the data of a provider as having an information quality; integrity and quality management practices that are consistent with the criteria of document DO-200A/ED-76. The operator provider (*e.g.*, an FMS company) must have an LOA Type 2 and its respective providers must have an LOA Type 1 or 2. AAC may accept a LOA submitted by navigation data providers or submit its own LOA.

6. AIRCRAFT MODIFICATIONS (DATA BASE UP TO DATE)

If an aircraft system required for APV/baro-VNAV operations is modified (*e.g.*, a change in the software), the operator is responsible for validating the APV/baro-VNAV procedures with the navigation database and the modified system. This can be done without direct assessment if the manufacturer verifies that the modification has no effect on the navigation database or on path calculation. If this verification is not done by the manufacturer, the operator must carry out an initial validation of the navigation data with the modified system.

APPENDIX 1
APV/baro-VNAV APPROVAL PROCESS

a) The APV/baro-VNAV approval process consists of two types of approvals: the airworthiness and operational approvals. Although the two have different requirements, they must be considered under a single process.

b) This process constitutes an orderly method used by the CAAs to ensure that applicants meet the established requirements.

c) The approval process consists of the following phases:

1) Phase one: Pre-application
2) Phase two: Formal application
3) Phase three: Review of the documentation
4) Phase four: Inspection and demonstration
5) Phase five: Approval

d) In *Phase one - Pre-application*, the CAA meets with the applicant or operator (pre-application meeting), who is advised of all the requirements it must meet during the approval process.

e) In *Phase two - Formal application*, the applicant or operator submits the formal application, accompanied by all the relevant documentation, as established in Section 17 of this AC.

f) In *Phase three - Review of documentation*, the CAA evaluates the documentation and the navigation system to determine their eligibility and the approval method to be applied with respect to the aircraft. As a result of this review and evaluation, the CAA may accept or reject the formal application together with the documentation.

g) In *Phase four - Inspection and demonstration*, the operator will train its personnel and conduct validation flights, if required.

h) In *Phase five - Approval*, the CAA issues the APV/baro-VNAV authorization once the operator has met the airworthiness and operational requirements. For LAR 121 and 135 operators, the CAA will issue the corresponding OpSpecs, and for LAR 91 operators, it will issue a LOA.

APPENDIX E

ADVISORY CIRCULAR

AC	**:**	**91-002**
DATE	**:**	**27/10/08**
REVISION	**:**	**Original**
ISSUED BY	**:**	**SRVSOP**

SUBJECT: AIRCRAFT AND OPERATORS APPROVAL FOR RNAV 5 OPERATIONS

1. PURPOSE

This advisory circular (AC) provides acceptable means of compliance of LAR requirements in respect to aircraft and operators approval for RNAV 5 operations.

An operator may use alternative means of compliance, as far as those means are acceptable for their respective Civil Aviation Authority (CAA).

The use of the verb in future or the word “must”, is applied to an applicant or operator choosing to fulfill the criteria described in this AC.

This AC also establishes the criteria when it is used the stand-alone GPS as the primary means of navigation in RNAV 5 operations (where the stand-alone GPS equipment provides the only RNAV capability installed onboard the aircraft).

2. LATIN AMERICAN AERONAUTICAL REGULATIONS (LAR) RELATED SECTIONS

LAR 91: Sections 91.880 (b) and 91.1650

LAR 121: Section 121.995 (b)

LAR 135: Section 135.570 (b)

3. RELATED DOCUMENTS

Doc 9613 Performance based navigation manual (PBN) and its related documentation

AMC 20-4 Airworthiness approval and operational criteria for the use of navigation systems in European airspace designated for Basic RNAV operations and its related documentation

AC 90-96A Approval of U.S. operators and aircraft to operate under instrument flight rules (IFR) in European airspace designated for basic area navigation (B-RNAV) and precision area navigation (P-RNAV) and its related documentation

CO 1/98 Resolution for operational approval and criteria for the use of navigation systems in European airspace designated for Basic RNAV operations

4. DEFINITIONS AND ABREVIATIONS

4.1 Definitions

a) **Navigation specifications**.- A set of aircraft and air crew requirements, needed to support performance based navigation operations within a defined airspace. There are two kinds of navigation specifications: RNAV and RNP. A RNAV specification does not include requirements for on-board performance monitoring and alerting. A RNP specification includes requirements for on-board performance monitoring and alerting.

b) **Performance based navigation (PBN)**.- Area navigation based on performance requirements for aircraft operating along an ATS route, on an instrument approach procedure or in a designated airspace.

Note.— Performance requirements are expressed in navigation specifications (RNAV specification, RNP specification) in terms of accuracy, integrity, continuity, availability and functionality needed for the proposed operation in the context of a particular airspace concept.

c) **Area navigation (RNAV)**.- A method of navigation which permits aircraft operation on any desired flight path within the coverage of ground or space-based navigation aids or within the limits of the capability of self-contained aids, or a combination of these.

Note.- Area navigation includes performance-based navigation as well as other operations that do not meet the definition of performance-based navigation.

d) **RNAV operations**.- Aircraft operations using area navigation for RNAV applications. RNAV operations include the use of area navigation for operations which are not developed in accordance with the PBN manual.

e) **Area navigation route**.- An Air traffic services (ATS) route established for the use of aircraft capable of employing area navigation.

f) **Global positioning system (GPS)**.- The United States Global navigation Satellite System (GNSS) is a satellite-based radio navigation system which utilizes precise range measurements to determine position, velocity and time in anywhere in the world. The GPS is composed by three elements: space, control, and user. The space element is formed of at least 24 satellites in 6 orbital planes. The control element consists of 5 monitor stations, 3 ground antennas, and a master control station. The user element consists of antennas and receivers that provide positioning, velocity and precise timing to the user.

g) **RNAV System**.- Area navigation system, which permits aircraft operation on any desired flight path within the coverage of ground or space-based navigation aids or within the limits of the capability of self-contained aids, or a combination of these. A RNAV system may be included as part of the Flight Management System (FMS)

h) **Receiver Autonomous Integrity Monitoring (RAIM)**.- A technique used within a GPS receiver/processor to determine the integrity of its navigation signals using only GPS signals, or GPS signals augmented with barometrical altitude data. This determination is achieved by a consistency check among redundant pseudo-orange measurements. At least one additional satellite needs to be available in respect to the number of satellites that are needed to obtain the navigation solution.

4.2 Abreviaturas

a)	CAA	Civil Aviation Authority
b)	ADF	Automatic direction finder
c)	AIRAC	Aeronautical information regulation and control
d)	AC	Advisory circular (FAA)
e)	AFM	Aircraft flight manual
f)	AMC	Aceptable means of compliance
g)	ATS	Air traffic services
h)	CA	Advisory circular (SRVSOP)
i)	CDI	Course deviation indicator
j)	CDU	Control display unit

k)	CO	Operacional Circular (Spain)
l)	DME	Distance measuring equiment
m)	DOP	Dilution of precision
n)	EASA	European Aviation Safety Agency
o)	FAA	Federal Aviation Administration
p)	FDE	Fault detection and exclusion
q)	FTE	Flight technical error
r)	GNSS	Global navigation satélite system
s)	GPS	Global positioning system
t)	HSI	Heading situation indicator
u)	IFR	Instrument flight rules
v)	INS	Inertial navigation system
w)	IRS	Inertial referente system
x)	IRU	Unidad de referencia inercial
y)	LAR	Latin American Regulations
z)	LORAN C	Long range navigation
aa)	MEL	Minimum equipment list
bb)	NDB	Non-directional beacon
cc)	ND	Navigation display
dd)	NOTAM	Notice to airmen
ee)	ICAO	Internacional Civil Aviation Orgatization
ff)	OM	Operations manual
gg)	PBN	Performance based navigation
hh)	PF	Pilot flying
ii)	PNF	Pilot not flying
jj)	POH	Pilot operating handboock
kk)	RAIM	Receiver autonomous integrity monitoring
ll)	RNAV	Area navigation
mm)	SA	Selective availability
nn)	TACAN	Tactical air navigation
oo)	TCDS	Type certificate data sheet
pp)	TLS	Target level of safety
qq)	TSO	Technical standard order
rr)	VOR	Very hight frecuency (VHF) omni-directional radio range

5. INTRODUCTION

5.1 In January 1998, the European Air Safety Agency (EASA) published the document related to the acceptable means of compliance (AMC 20-4) which replaced the Temporary guidance Leaflet No. 2 (TGL No. 2) issued by former JAA. This AMC contains acceptable means of compliance related to airworthiness approval and operational criteria for the use of navigation systems in European air space designated for basic area navigation operations (Basic RNAV or B-RNAV).

5.2 In the same manner, the Federal Aviation Administration (FAA) of the United States (U.S.) replaced the AC 90-96 of March 1998 by AC 90-96A issued in January 2005. This new circular provides guidance material in regards to the airworthiness and operational approval for operators of U.S. registered civil aircraft operating in European air space designated for Basic area navigation (B-RNAV) and Precision area navigation (P-RNAV).

5.3 Both current documents, AMC 20-4 and AC 90-96A, require similar operational and functional requirements.

5.4 In the context of the terminology adopted in the Performance based navigation manual (PBN manual) of the International Civil Aviation Organization (ICAO), B-RNAV requirements are termed RNAV 5.

5.5 The basis of specifications developed by EASA and FAA are supported on the capacity of RNAV equipments incorporated in the early 70s.

5.6 Since RNAV 5 operations implementation is accomplish in areas where there is no surveillance, such implementation requires an increase in route spacing to assure compliance of the Target level of safety (TLS).

5.7 RNAV 5 specification does not require an alert to the pilot in the event of excessive navigation errors, neither requires two RNAV Systems, thus, the potential for loss of RNAV capability requires the aircraft to be provided of an alternative navigation source.

5.8 The performance level selected for RNAV operations allows a wide range of RNAV systems to be approved for these operations, including INS with a two hour limit after its last alignment/position update performed on the ground, when they do not have a function for automatic radio updating of aircraft position.

5.9 Although RNAV 5 specification does not include requirements for on-board performance monitoring and alerting, it does require that the on-board equipment keeps a lateral and longitudinal navigation accuracy on route of $\pm$ 5 NM or better during 95% of the total flight time.

6. NAVAID INFRASTRUCTURE

6.1 RNAV 5 systems allow an aircraft to navigate along any desired flight path within the coverage of ground or space-based navigation aids or within the limits of the capability of self-contained aids, or a combination of both methods.

6.2 RNAV operations are based in the use of RNAV equipment that automatically determines aircraft position in the horizontal plane using inputs from one or a combination of the following types of position sensors, together with the means to establish and follow a desired path:

a) VOR/DME;

b) DME/DME;

c) INS o IRS;

d) LORAN C; and

e) GNSS or GPS

Note.- the application of the sensors is subject to the limitations contained in this AC.

6.3 It is acceptable to exist gaps in the navigation aid coverage, although, if this occurs, it must be considered route spacing and obstacle clearance surfaces for the expected increase in lateral track keeping errors during the “dead reckoning” phase of flight.

7. AIRWORTHINESS AND OPERATIONAL APPROVAL

7.1 In order to the operator receives an RNAV 5 authorization, this must comply with two types of approval:

a) Airworthiness approval in charge of the State of registry; (See Art. 31, Chicago Agreement, Paragraph 5.2.3 and 8.1.1 of Annex 6, Part I; and

b) Operational approval required by the State of the operator (See paragraph 4.2.1 and Addendum F of Annex 6 Part I).

7.2 For general aviation operators, the State of registration (See paragraph 2.5.2.2 of Annex 6 Part II) will submit a Letter of Appointment (LOA) once determined that the aircraft accomplishes all applicable requirements of this document for RNAV 5 operations.

7.3 Compliance with airworthiness requirements by themselves does not constitute the operational approval.

8. AIRWORTHINESS APPROVAL

8.1 Aircraft equipment

a) An aircraft may be considered eligible for an RNAV 5 approval if it is equipped with one or more navigation systems approved and installed in accordance with the guide included in this document.

b) An aircraft capacity to perform RNAV 5 operations can be demonstrated or reached in the following cases

1) First case: Demonstrated capacity in the manufacturing process and declared in the Aircraft flight manual (AFM) or in the AFM supplement or in the Type certificate data sheet (TCDS) or in the Pilot operating handbook (POH).

2) Second case: Capacity reached in-service:

i. Through an evaluation of the navigation system of the aircraft which allows to determine its eligibility.

8.2 Eligibility based on AFM or AFM supplement or TCDS or POH. To determine eligibility of the aircraft in function of AFM or AFM supplement, TCDS or POH, aircraft RNAV 5 capacity must have been demonstrated in production (aircraft in manufacturing process or new construction).

a) **Aircraft RNAV 5 systems eligibility.**

1) An aircraft may be considered eligible for RNAV 5 operations, if AFM or AFM supplement or TCDS or POH shows the appropriate instruments flight rules (IFR) navigation system installation has received airworthiness approval in accordance with this AC or AMC 20-4 or with one of the following FAA documents:

i. AC 90-96, AC 90-45A, AC 20-121A, AC 20-130, AC 20-138 o AC 25-15

2) Airworthiness approval guidance included in this AC provides aircraft navigation performance equivalent to EASA AMC 20-4 and FAA AC 90-96A.

3) Once aircraft eligibility has been established, operator approval will proceed, according to paragraph 9 of this AC.

b) **LAR 91 aircraft approval**

1) LAR 91 operators should revise the AFM or AFM supplement or TCDS or POH to assure that the aircraft navigation system is eligible to perform RNAV 5 operations, according to describe on paragraph 8.2 a) 1) of this AC.

2) After having determined eligibility of the navigation system, LAR 91 operators will present respective documents to the AAC.

3) In case LAR 91 operators are not able to determine, based on the AFM or AFM supplement or TCDS or POH, whether the Aircraft system has been installed and approved according with an appropriate CA or AC or AMC, they will proceed according to paragraph 8.3. of this document.

c) **LAR 121 and/or 135 aircraft approval**

1) LAR 121 and/or 135 operators will present the following documents to AAC:

i. Sections of the AFM or AFM supplement or TCDS that document airworthiness approval in accordance with this AC or with mentioned documents in paragraph 8.2 a) 1) of the this document.

2) These operators will ensure that the aircraft navigation system will meet the functions required in paragraph 8.6 of this CA.

3) In case a LAR 121 and/ or 135 operator is not able to determine, based on the AFM or AFM supplement or TCDS, whether the system has been installed and approved according to an appropriate CA or AC or AMC, it will proceed in accordance with to the steps established in the following paragraph.

8.3 Eligibility not based on AFM or TCDS or AFM Supplement or POH – RNAV 5 capacity reached during service.

a) *Determination of the aircraft eligibility through evaluation of its navigation equipment.*

1) The operator makes a request for assessment of aircraft RNAV equipment for eligibility to the airworthiness inspection Direction or equivalent CAA entity. The operator, together with the request, will provide the following:

i. RNAV system make, model and part number;

ii. evidence that the equipment meets lateral and longitudinal navigation accuracy on route of $\pm$ 5 NM or better during 95% of the total flight time. This can be determined through the evaluation of system design. Evidence of meeting the requirements of another AC can be used for this purpose.

iii. proof that the system meets the required functions for RNAV 5 operations described in this CA on paragraph 8.6.

iv. crew operating procedures and bulletins; and

v. any other pertinent information required by the CAA.

2) in case the airworthiness inspection Direction or CAA equivalent entity is not able to determine RNAV equipment eligibility, evaluation request together with supporting documents will be forward to the aircraft certification Direction or equivalent entity from the State of registry. In any case, aircraft certification Division or equivalent will inform to airworthiness inspection Direction or CAA equivalent entity about the eligibility of the proposed equipment to perform RNAV 5 operations.

3) *LAR 91 Operators*.- Once the CAA has determined the aircraft equipment is eligible for RNAV 5 operations, the airworthiness inspection Direction or CAA equivalent entity will issue a letter of finding documenting that the aircraft RNAV equipment is eligible to perform those operations.

4) *LAR 121 or 135 operators*.- The CAA will verify aircraft RNAV system eligibility including the required functions on paragraph 8.6 of this AC.

8.4 Limitations on the design and/or use of navigation systems.- Although the following navigation systems offer RNAV capability, these present limitations for their use in RNAV 5 operations.

a) **Inertial navigation systems/Inertial reference systems (INS/IRS)**

1) Inertial systems may be used either as a stand alone inertial navigation system (INS) or as an inertial reference (IRS) acting as part of a multi-sensor RNAV system where inertial sensors provides augmentation to the basic position sensors as well as a reversionary position data source when out of cover of radio navigation sources.

2) INS without a function for automatic radio updating of aircraft position and approved in accordance with FAA AC 25-4, when complying with the functional criteria of paragraph 8.6 of this AC, may be used only for a maximum of two (2) hours from the last alignment/position update performed on ground. Consideration may be given to specific INS configurations (e.g. triple mix) where either equipment or aircraft manufacturer's data justifies extended use from the last position update.

3) INS without automatic radio updating of aircraft position, including those systems where manual selection of radio channels is performed in accordance with flight crew procedures, must be approved n accordance with FAA AC 90-45A or AC 20-130A or any other equivalent document.

b) **VHF omni-directional radio range (VOR)**

1) VOR accuracy can typically meet accuracy requirements for RNAV 5 up to 60 NM from the navigation aid and Doppler VOR up to 75 NM. Specific regions within the VOR coverage may experience larger due to propagation effect (e.g. multipath). Where such errors exist this can be accommodated by prescribing areas where the affected VOR may not be used.

c) **Distance measuring equiment (DME)**

1) DME signals are considered sufficient to meet requirements of RNAV 5 wherever the signals are received and there is no closer DME on the same channel, regardless of the published coverage volume. Where the RNAV 5 system does not take account of published "Designated operational coverage" of the DME, the RNAV system must execute data integrity checks to confirm that the correct DME signal is being received.

d) **Long Range Navigation (LORAN C)**

1) Use of Loran-C, in compliance with FAA AC 20-121A, is considered an acceptable means to comply with RNAV 5 in those areas and on routes with acceptable Loran-C coverage. Loran-C users must refer to the AFM or POH to determine if operational use of the Loran system is limited to a specified Loran-C Operational Area.

e) **Global navigation satellite system (GNSS)**

1) **Global positioning system (GPS)**

i. The use of GPS to perform RNAV 5 operations is limited to equipment approved in accordance with the TSO-C 129(), TSO-C-145() and TSO-C-146() from FAA or ETSO-129(), ETSO-145() and ETSO-146() from EASA or equivalent documents which include the minimum systems functions specified in the present CA on Paragraph 8.6.

ii. The integrity of GPS system must be provided by the receiver autonomous integrity monitoring (RAIM) or an equivalent means within a multi-sensor navigation system. The equipment must be approved in accordance with the AMC 20-5 or equivalent document. In addition, stand-alone GPS equipment must include the following functions according to the TSO-C 129A or ETSO-129A criteria:

- Pseudorange step detection; and
- Health word checking

iii. Compliance with these two requirements can be determined the following way:

- A statement in the AFM or POH indicating the GPS equipment meets the criteria for primary means of navigation in oceanic and remote airspace; or
- a placard on the GPS receiver certifying it meets TSO-C 129A, TSO-C-145A and TSO-C-146A from FAA or ETSO-129A, ESTO-145A and ESTO-146A from EASA; or
- a CAA letter of design approval for the applicable equipment. Operators should contact the avionic equipment's manufacturer to determine if the equipment complies with these requirements and ask if a letter of design approval is available. Manufacturers may obtain this letter by submitting appropriate documentation to the certifications offices of the States of aircraft design or manufacturer. Operators will keep the letter of design approval within the AFM or POH as evidence of the RNAV 5 eligibility. Any limitations included in the letter of design approval should be reflected in a letter of finding to LAR 91 operators or in the operations specifications (OpSpecs) for LAR 121 and/or 135 operators.

iv. Traditional navigation equipment (e.g., VOR, DME and automatic direction finder (ADF)) must be installed and operative, so as to provide an alternative navigation means of navigation.

v. Where approval for RNAV 5 requires the use of traditional navigation equipment as a back up in the event of loss of GPS, the required navigation aids as defined in the approval (e.g. VOR, DME and/or Non directional beacon (NDB)) must be installed and serviceable.

2) **Stand-alone GPS equipment**

i. Stand-alone GPS equipment approved in accordance with guidance provided in this AC, may be used in RNAV 5 operations, subject to the limitations included in this document. Such equipment must be operated in accordance with procedures acceptable to the CAA. The flight crew must receive appropriate training for use the stand-alone GPS equipment regarding normal and contingency procedures detailed in the Paragraph 10 of this AC.

8.5 RNAV-5 system requirements

a) Accuracy

1) The navigation performance of aircraft approved for RNAV 5 requires a track keeping accuracy equal to or better than $\pm$ 5 NM during the 95% of the flight time. This value includes signal source error, airborne receiver error, display system error and flight technical error (FTE).

2) This navigation performance assumes the necessary coverage provided by satellite or ground based navigation aids is available for the intended route to be flown.

b) Availability and integrity

The minimum level of availability and integrity required for RNAV 5 systems can be met by a single installed system comprising by:

1) one sensor or a combination of the following sensors: VOR/DME, DME/DME, INS or IRS, LORAN C and GNSS or GPS;

2) RNAV computer;

3) control display unit (CDU); and

4) navigation display(s) [(e.g. navigation display (ND), horizontal situation indicator (HSI) or course indicator deviation (CDI)].

provided that the system is monitored by the flight crew and that in the event o a system failure the aircraft retains the capability to navigate relative to ground based navigation aids (e.g. VOR, DME and NDB).

8.6 Functional requirements

a) *Required Functions*.- The following system functions are the minimum required to conduct RNAV 5 operations:

1) Continuous indication of the aircraft position relative to track to be displayed to the pilot flying (PF) on a navigation display situated in his primary field of view;

2) In addition, where the minimum flight crew is two pilots, indication of the aircraft position relative to track to be displayed to the pilot not flying (PNF) on a navigation display situated in his primary field of view.

3) Display of distance and bearing to the active (To) waypoint;

4) Display of ground speed or time to active (To) waypoint;

5) Storage of a minimum of 4 waypoints; and

6) Appropriate failure indication of the RNAV system, including the sensors failure.

b) *RNAV 5 navigation displays*

1) Navigation data must be available for display either on a display forming part of the RNAV equipment or on a lateral deviation display (e.g. CDI, (E)HSI, or a navigation map display).

2) These displays must be used as primary flight instruments for the navigation of the aircraft, for maneuver anticipation and for failure/status/integrity indication. They should meet the following requirements:

   i. The displays must be visible to the pilot when looking forward along the flight path.

   ii. The lateral deviation display scaling should be compatible with any alerting and annunciation limits, where implemented.

   iii. The lateral deviation display must have a scaling and full-scale deflection suitable for the RNAV 5 operation.

9. OPERATIONAL APPROVAL

9.1 *Requirements to obtain the operational approval*.- To obtain the operational approval, the operator will comply with the following steps considering the operational procedures established in Paragraph 10 of this AC.

a) *Airworthiness approval*.- The Aircraft must have the corresponding airworthiness approvals as mentioned in Paragraph 8 of this CA.

b) *Documentation*.- The operator will present to the AAC the following documents:

1) The application for RNAV 5 operational approval;

2) Amendments to the operations manual (OM) which must include operations procedures according to what is described in Paragraph 10 of this CA, for crews and dispatchers, if applicable;

3) Amendments, when applicable, of maintenance manuals and programs which must have the maintenance procedures for the new equipment, as well as the training of the maintenance associated personnel;

4) A copy of the AFM parts, or AFM supplement or TCDS or POH, to verify the airworthiness approval for RNAV 5 for each affected aircraft;

5) The amendments to the Minimum Equipment List (MEL), which must identify the minimum necessary equipment to comply with RNAV 5; and

6) Training programs or amendments to the operator's training program for crews and flight dispatchers, if applicable, according to what is described in Paragraph 11 of this document;

c) *Training*.- Once the amendments to manuals, programs and documents have been accepted or approved, the operator will provide required training to its personnel.

d) *Validation flights*.- The AAC may perform a validation flight, if determines it is necessary in the interest of safety.

9.2 *Authorization issuance to perform RNAV 5 operations*.- Once the operator has successfully completed the operational approval process, the AAC will issue the operator, when applicable, the corresponding authorization to perform RNAV 5 operations.

a) *LAR 91 operators*.- For LAR 91 operators, the AAC does will issue a letter of authorization (LOA).

b) LAR 121 and/or 135 operators.- For LAR 121 and/or LAR 135 operators, the AAC will issue the corresponding OpSpecs, which will show RNAV 5 authorization.

10. OPERATION PROCEDURES

10.1 *Flight planning.*

a) Before operating on a RNAV 5 route, the operator will ensure that:

1) The aircraft counts on a RNAV 5 approval;

2) Routes correspond to the authorization;

3) The necessary equipment to operate RNAV 5 work correctly and are not degraded;

4) Navigation aids based on space or ground are available;

5) The crews check the contingency procedures.

b) *Stand-alone GPS equipment.* During the planning phase the following procedures must be accomplish in regards to the stand-alone GPS equipment:

1) An aircraft can depart without further action in the following cases, when:

i. all satellites are scheduled to be in service; or

ii. one satellite is scheduled to be out of service in case of GPS equipment that includes barometrical altitude.

2) The availability of GPS integrity RAIM shall be confirmed for the intended flight (route and time) through the use of a prediction program either ground-based or incorporated in the on-board system, following the criteria established in Appendix 1 of the CAA, when:

i. any satellite is scheduled to be out of service; or

ii. more than one satellite is scheduled to be out of service in case of GPS equipment that includes barometric altitude.

3) This prediction is required for any route and route segment RNAV 5 based upon the use of GPS.

4) The specified route of flight, including trajectory to any alternative aerodrome will be defined by a series of waypoints and by the estimated time of pass over them for a speed or series of speed, which at the same time will be in function of the intensity and previous wind direction.

5) Taking in consideration that during flight may occur deviations in regards to the specified ground speedy, prediction must be done using different speeds within the predictable margin for them.

6) Prediction program must be executed with a maximum anticipation of two hours preview to the flight departure. The operator will confirm that data about the state of the constellation and GPS ephemerides, have been updated with the latest information distributed by notice to airmen (NOTAM).

7) In order to get exact prediction, the program will allow manual de-selection of satellites considered non operative, as well as selection of those back to service condition during the flight time.

8) The operator will not dispatch or release a flight in case of continuous prediction loss of RAM higher than 5 minutes to any part of the previewed route. In this event, flight can be delayed, cancelled or re-routed in which RAM requirements may be accomplished.

c) *ATS – ICAO flight plan*.- At the time to file the ATS flight plan, authorized aircraft operators on RNAV 5 route, will insert corresponding code on flight plan form's box 10 (equipment), as defined within ICAO Doc 7030 for these operations.

10.2 Preview flight procedures at the aircraft.- The crew will perform on the aircraft the following procedures preview to the flight:

a) check registrations and forms to be sure that maintenance actions have been taken in order to correct defects in the equipment; and

b) check data base validation (current AIRAC cycle), if it is installed.

10.3 *En route operations*.

a) The crew will assure the aircraft correct functioning of its navigation system during its operation in a RNAV 5 route, confirming that:

1) necessary RNAV 5 equipment have not degraded during flight;

2) route corresponds to the authorization;

3) aircraft navigation accuracy is pertinent for RNAV 5, assuring this through pertinent cross check; and

4) others navigation aids (for example VOR, DME y ADF) must be selected in a way to permit a cross check or immediate reversion in the event of a RNAV capacity loss.

10.4 *Contingency procedures*.

a) Flight crews must familiarize with the following general provisions:

1) An aircraft must not enter or continue the operations in airspace designated as RNAV 5, according to the present ATC authorization, if because of a failure or degradation the navigation systems falls under RNAV 5 requirements, the pilot will obtain as soon as possible an amended authorization;

2) According to ATC instructions, operations will continue in regards to the present ATC authorization, or when not possible, will be requested a revised authorization to return to the VOR/DME conventional navigation;

3) in the event of communications failure, the flight crew must continue with the flight plan, in accordance with the published lost communication procedures; and

4) in any case, the crew must follow contingency procedures established for every operation region, and obtain an ATC authorization as soon as possible.

b) Stand-alone GPS equipment.

1) The operating procedures must identify the flight crew actions required in the event of RAIM function loss or exceedance of integrity alarm limit (erroneous position). This procedures must include:

i. In case of loss of the RAIM detection function.- The flight crew may continue navigating with the GPS equipment. The flight crew should attempt to cross-check the aircraft position with the information provided for the ICAO conventional navaids: VOR, DME and ADF, in order to confirm the existence of a required level of precision. In other case, the crew must revert to an alternative navigation means;

ii. In the event of an observed failure (including the failure of a satellite impacting the performance of the navigation systems based on GPS), the flight crew must revert to an alternative means of navigation.

iii. In case of exceedance of the alarm limit.- The flight crew must revert to an alternative means of navigation.

2) *On-board equipment availability VOR, DME, TACAN or ADF*.- The operator must have installed on the aircraft the VOR, DME, TACAN or ADF on-board equipment capacity according to the applied rules of operation LAR 91, 121 and 135. This capacity must be available along the intended route of flight to assure the availability of navigation alternative means in case of a GPS/RNAV system failure.

c) Any incidence registered in flight must be notified to the AAC in a maximum time of seventy two hours, unless justified cause.

11. NAVIGATION ERROR REPORTS FOLLOW UP PROCESS

a) The operator will establish a process to receive, analyze and do a follow up of the navigation error reports which allow determine the appropriate corrective action.

b) Repetitive navigation error occurrences, attributed to a specific part of the navigation equipment must be analyzed in order to correct its cause.

c) The nature and severity of the error may result in temporary withdrawn of the authorization to use the navigation equipment until the cause of the problem has been identified and rectified.

12. INSTRUCTION PROGRAM

a) The training programs for flight crews and flight dispatchers, if correspond, must be reviewed and approved by the AAC. The operator will included at least the following modules:

1) Required equipments, capacities, limitations and operation of these equipments in RNAV 5 airspace.

2) The routes and airspace for which the RNAV system is approved to operate.

3) The navaid limitations in respect of the operation of the RNAV system to be used for the RNAV 5 operation.

4) Contingency procedures for RNAV failures.

5) The Radio/Telephony Phraseology for the airspace in accordance to Doc 4444 and Doc 7030 as appropriate.

6) The flight planning requirements for the RNAV operation.

7) RNAV requirements as determined from chart depiction and textual description.

8) RNAV 5 en route procedures;

9) Methods to reduce navigation errors through dead-reckoning techniques.

10) RNAV system-specific information, including:

i. Levels of automation, mode annunciations, changes, alerts, interactions, reversions, and degradation.

ii. Functional integration with other aircraft systems.

iii. Monitoring procedures for each phase of flight (for example, monitor PROG or LEGS page).

iv. Types of navigation sensors (for example, DME, IRU, GNSS) utilized by the RNAV system and associated system prioritization/weighting/logic.

v. Turn anticipation with consideration to speed and altitude effects.

vi. Interpretation of electronic displays and symbols.

11) RNAV equipment operating procedures, as applicable, including how to perform the following actions:

i. Verify currency of aircraft navigation data.

ii. Verify successful completion of RNAV system self-tests.

iii. Initialize RNAV system position.

iv. Fly direct to a waypoint.

v. Intercept a course/track.

vi. Be vectored off and rejoin a procedure.

vii. Determine cross-track error/deviation.

viii. Remove and reselect navigation sensor input.

ix. When required, confirm exclusion of a specific navigation aid or navigation aid type.

x. Perform gross navigation error check using conventional navigation aids.

b) Training program on the GPS as a primary means of navigation.

1) Besides the training modules describe on the previous paragraphs, operators' training programs which use RNAV systems based on GPS as a primary navigation means will include modules described in Appendix 2.

Appendix 1

GPS integrity monitoring (RAIM) prediction program

Where a GPS integrity monitoring (RAIM) prediction program is used as a means of compliance with paragraph 5.2 (a) of this document, it should meet the following criteria:

a) The program should provide prediction of availability of the integrity monitoring (RAIM) function of the GPS equipment, suitable for conducting RNAV 5 operations in designated European airspace.

b) The prediction program software should be developed in accordance with at least RTCA DO 178B/EUROCAE 12B, Level D guidelines.

c) The program should use either a RAM algorithm identical to that used in the airborne equipment or an algorithm based on assumptions for RAIM prediction that give a ore conservative result.

d) The program should calculate AIM availability based on a satellite mask angle of no less than 5 degrees, except where use of lower mask angle has been demonstrated to be acceptable to the authority.

e) The program should have the capability to manually designate GPS satellites which have been notified as being out of service for the intended flight.

f) The program should allow the user to select:

   1) the intended route and declared alternates; and

   2) the time and duration of the intended flight.

PÁGINA DEJADA INTENCIONALMENTE EN BLANCO

Appendix 2

Training program on the GPS as a primary means of navigation

The training programs for flight crews that use RNAV 5 systems based on the GPS as a primary means of navigation, will include a segment with the following training modules:

a) GPS system components and operating principles.- Understanding of the GPS system and its operating principles:

   1) GPS system components: control segment, user segment, and space segment;

   2) on-board equipment requirements;

   3) GPS satellite signals and pseudo-random code;

   4) positioning principle;

   5) receiver clock error;

   6) masking function;

   7) performance limitations of the different types of equipment;

   8) WGS84 coordinate system;

b) Navigation system performance requirements.- Define the following terms in relation to the navigation system and evaluate the degree of compliance by the GPS system of the requirements associated with the following terms:

   1) precision;

   2) integrity;

      i. means to improve GPS integrity: RAIM and FDE

   3) availability;

   4) service continuity

c) Authorizations and documentation.- Requirements applicable to pilots and navigation equipment for GPS operation:

   1) pilot training requirements;

   2) aircraft equipment requirements;

   3) AFM system certification criteria and limitations;

   4) GPS-related NOTAMs.

d) GPS system errors and limitations.- Cause and magnitude of typical GPS errors:

   1) ephemerides;

   2) clock;

   3) receiver;

   4) atmospheric/ionospheric;

   5) multi-reflection;

   6) selective availability (SA);

   7) total typical error associated to the C/A code;

   8) effect of the dilution of precision (DOP) on the position;

9) susceptibility to interference;

10) comparison of vertical and horizontal errors; and

11) path-tracking precision. Collision avoidance.

e) Human factors and GPS.- Limitations on the use of GPS equipment due to human factors. Operating procedures that offer protection against navigation errors and loss of awareness of the real situation due to the following causes:

1) mode errors;

2) data entry errors;

3) data checks and validation, including independent cross-checking procedures;

4) automation-induced relaxation;

5) lack of standardization of GPS equipment;

6) information processing by humans and situational awareness.

f) GPS equipment – Specific navigation procedures.- Knowledge of the appropriate operating procedures for GPS in the typical navigation tasks for each specific type of equipment in each type of aircraft that includes:

1) selection of the appropriate operating mode;

2) review of the different types of information contained in the navigation database;

3) forecast of the availability of the RAIM function;

4) procedure for entering and checking the waypoints defined by the user;

5) procedure for entering, retrieving and checking flight plan data;

6) interpretation of the typical information shown on the GPS navigation display: LAT/LONG, distance and heading to the waypoint, CDI;

7) interception and maintenance of the GPS-defined routes;

8) in-flight determination of ground speed (GS), estimated time of arrival (ETA), time and distance to the waypoint;

9) indication of waypoints over flight;

10) use of the “DIRECT TO” function;

11) use of the “NEAREST AIRPORT” function;

12) use of the GPS in GPS or DME/GPS arrival procedures.

g) Verification of GPS equipment.- For each type of equipment in each aircraft, the following operational and start-up checks must be conducted at the appropriate time:

1) constellation status;

2) RAIM and FDE functional status;

3) dilution of precision (DOP) status;

4) currency of the instrument flight rules (IFR) database;

5) receiver operating condition;

6) CDI sensitivity;

7) position indication.

h) GPS messages and warnings.- For each type of equipment in each aircraft, timely action must be recognized and taken in face of GPS messages and warnings, including the following:

1) loss of RAIM function;
2) 2D/3D navigation;
3) dead-reckoning navigation mode;
4) database not updated;
5) loss of the database;
6) GPS equipment failure;
7) barometric data entry failure;
8) power failure;
9) prolonged parallel displacement; and
10) satellite failure.

PÁGINA DEJADA INTENCIONALMENTE EN BLANCO

Appendix 3

RNAV 5 approval process

a) The RNAV 5 approval process is comprised of two types of approvals: the airworthiness approval and the operational approval, even though, they have different requirements, both must be considered under one process only.

b) This process constitutes a well-arrange method, which is used by the CAA to ensure the applicants comply with the established requirements.

c) The approval process is conformed by the following phases:

1) Phase one: Pre-application

2) Phase two: Formal application

3) Phase three: Analysis of the documentation

4) Phase four: Demonstration and inspection

5) Phase five: Approval

d) *In Phase One - Pre-aplication*, the CAA holds a meeting with the operator (the pre-aplication meeting), in which the operator will be informed about all the requirements that he needs to comply during the approval process.

e) *In Phase Two - Formal application*, the operator submits the formal application with all applicable documents.

f) *In Phase Three - Analysis of the documentation*, the CAA reviews the submission and evaluates the navigation equipment in order to determine the method of approval (aircraft equipment eligibility). As a result of this evaluation the CAA may accept or return the Formal Application with the documentation.

g) *In Phase Four - Demonstration and inspection*, the operator will accomplish the training program and the validation flight if this is required by the CAA, otherwise the process will advance to the next phase.

h) *In phase Five - Approval*, the CAA issues the RNAV 5 authorization, once the operator has completed the airworthiness and operations requirements. For LAR 121 and/or 135 operators, the AAC will issue the OpSpecs. For LAR 91, a LOA is nor required if the aircraft eligibility has been determined based on the AFM or POH or associated documentation.

PÁGINA DEJADA INTENCIONALMENTE EN BLANCO

APPENDIX F

APENDICE F / APPENDIX F

CAPACIDAD PBN DE LAS AERONAVES

PBN AIRCRAFT CAPACITY

1. Explotador :
Operator:

Fecha:
Date

2. Aeronave Aircraft		3. Capacidad RNAV RNAV Capacity (AFM)					4. Capacidad RNP Capacity (AFM) RNP					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 TSO C129A/C145A/C146A						
Matrícula Register	Modelo Model	10 (RNP 10)	5	2	1	P-RNAV	4	2	1	RNP APCH	RNP AR APCH					Single	Dual	RAIM o AAIM	FDE	No	Single	Dual

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.

1.

2. 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 "Matricula", 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.

3. 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 capacilities 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.

4. 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.

5. 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.

6. 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.

7. 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

8. IntegridadIntegrity: marque con una X, según corresponda, si el sistema GNSS de la aeronave dispone de medios para asegurar la integridad de los señales de navegacion GPS (Vigilancia autónoma de la integridad en el receptor (RAIM) y de deteccion de fallas o exclusion (FDE). / Mark with an X, as required, if GNSS aicraft System has means to ensure integrity of GPS navigation signals. (Receptor Autonomous surveillance of receptor integrity (RAIM) and detection of failures or exclusion (FDE).

9. 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 :
Operator: CONDOR

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/PrimaryTSO C129A/C145A/C146A				No	Single	Dual
Matrícula Register	Modelo Model	10 (RNP 10)	5	2	1	P-RNAV	4	2	1	APRCH					Single	Dual	RAIM o AAIM	FDE			
BB-MEL	DHC-8-200	-	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

Agenda Item 5: Implementation of air traffic flow management (ATFM) in the SAM Region

5.1 The SAM/IG/1 meeting, among other matters, analysed issues related with ATFM implementation in the South American Region, and agreed to develop a survey in order to obtain and supplement the information aimed at learning about the situation of participating States and organisations, regarding the Methodology for the Calculation of Airport and ATC Capacity and ATFM procedures for the Airport Strategic Phase, Airport Tactical Phase, Airspace Strategic Phase, and Airspace Tactical Phase.

5.2 With regard to the above, the Meeting observed that from 14 States polled, 11 States of the SAM Region replied the survey shown in **Appendix A** to this part of the report., and some information was therein highlighted, same which is detailed below:

Calculation methodology for airport capacity and ATC sectors

5.3 Under this agenda item, the meeting observed that a high percentage of States of the SAM Region did not have a basic or complex method to estimate airport capacity, of en-route sector or procedures to support the different ATFM phases.

5.4 On the other hand, the meeting recalled that under the sponsorship of Regional Project 06/901, SAM States were invited to participate in a Course on the Calculation of Airport and ATC Sector Capacity offered free-of-cost by the Brazilian Administration in Rio, on 23-27 March 2009, at the facilities of the Air Navigation Management Centre (CGNA) the purpose of which was to present the methodology for estimating runway and ATC sector capacity applied in Brazil.

5.5 The level of the material and instructors at the course offered by the Brazilian Administration at the CGNA facilities was excellent, just like the hands-on exercises carried out at the ATC facilities of the Galeon Ariport in Rio. Most South American States participated in the course, and one representative of the ICAO SAM Office.

5.6 With regard to the above, the meeting deemed pertinent that States which assisted to this Course on airport capacity and ATC sectors, carry out some exercises in airports and sectors selected of their airspace, even if it was not justifiable from the demand point of view, in order to obtain the following objectives:

a) Application of knowledge acquired in the airport capacitycourse;

b) Training of its personnel for the measuring and estimation tasks;

c) Creation of an initial base line for ATFM use, which shall serve for statistical purposes and forecasting, in order to:

1) Improve capacity management
2) Improve infrastructure
3) Planning of human resources and optimisation of tasks
4) Budgetary planning
5) Other related issues.

d) Feedback of the results of the application of the methodology in order to adjust and improve the uniform application of an homogeneous methodology for the region.

5.7 With regard to the above, the importance to formulate the following conclusion was emphasized:

Conclusion SAM/IG/3-5 Runway capacity of an international airport and ATC associated sector

SAM States are encouraged to carry out at least an exercise to determine the runway capacity of an international airport and ATC sector, associated or another one selected for each State, to present the results to the SAM/IG/4 Meeting, providing the following information:

a) Amount of personnel trained for the exercise
b) Methodology applied
c) Result of the exercise, providing the declared capacity for each runway and ATC selected sector.
d) Identification of problems found in the methodology applied.

5.8 The meeting noted and thanked Brazil their offer to provide the necessary advise to whoever request it, for the holding of these exercises, using the contacts provided in the course within the Brazilian Administration.

5.9 Also, and as a support to these actions, the meeting decided to continue with the plans of Project RLA/06/901 in terms of drafting a guide for applying a common methodology for calculating airport and ATC sector capacity in the SAM Region, seeking the harmonisation of said methodology with those used in other regions.

Processing and visualisation of data for air traffic flow management

5.10 In analysing the information provided on this matter, the meeting noted that most of the States have systems to process and visualise FPL data, and that the airspace data base (WGS-84, NAVAIDS) coordinates and airport information is well advanced.

Surveillance and automation systems to support ATFM

5.11 It was also verified that most of the administrations do not have an ATFM system to visualise air traffic, and it also lacks of an automated system for messages exchange to support ATFM, in order to monitor and visualise the sector capacity of en-route sector and population and aircraft diversity.

5.12 The meeting noted also that most of the States have automated surveillance systems for ATFM support as well as AIS/MAP data bases but not all of them are available in electronic format.

Meteorological information

5.13 The meeting recognised that most of the States have access to meteorological products listed in the survey and it is understood that procedures should be established so that this information may be shared by ATFM units.

Historical and statistical data

5.14 With regard to this matter, the meeting was informed with pleasure that all States polled have historical and statistical data available to support air traffic operations and meteorological activities.

Communications systems and CDM processes and coordination between units

5.15 In analysing these systems, it was noted that most of the States have sufficient infrastructure so as to establish communications and carry out coordination with other units of their interest, to support collaboration in decision making (CDM).

5.16 Based on the above, the meeting understood that States should be encouraged to establish operational agreements and necessary communication links for this activity as per Letter of Operational Agreement Model. This model shall be presented in Chapter 4 – Communications, and Coordination of the ATFM Manual for the standardised use between ATFM units.

5.17 The result of this survey with updated data provided by delegates of States are shown in **Appendix B** to this part of the report. This document is the base line with regard to ATFM.

ATFM Manual

5.18 The meeting noted the Plans of Project RLA/06/901 to continue developing an ATFM Manual for the SAM Region and to put at the disposal of CAR Region the same for the pertinent use. In this connection, the meeting considered appropriate that once the document draft is prepared, it should be sent in electronic format to ATFM focal points, so that it may be analysed and in this manner make the necessary contributions. Ten days will be available so that these focal points submit their comments. The final draft shall be presented to the SAM/IG/4 Meeting

ATFM training courses

5.19 With regard to the above, the meeting thanked again the offer of Brazil to dictate a course on air traffic flow management (ATFM) for the first quarter of 2010, and in this connection, it requested ICAO Secretariat to invite all SAM States, and also to take the pertinent actions to that Regional Project RLA/06/901 may host the participation of delegates from member States of this project.

Tasks to be developed by the Project in the ATFM area

5.20 With regard to the tasks to be carried out by Project RLA/06/901 for 2010, the meeting noted the following:

a) The hiring of an expert for the development of the second part of the ATFM Manual.

b) Host to member States to attend the ATFM course in Brazil.

ATFM action plan

5.21 Also, the meeting analysed and reviewed the ATFM action plan for the SAM Region and after fruitful discussions the corresponding changes were made, and are shown in **Appendix C** to this part of the report.

Administrative matters

5.22 The meeting noted the resignation of the delegate of Argentina as ATFM Rapporteur, and consequently, decided that Mr. José Vagner Vital, from Brazil, assume this function.

APPENDIX A

SAM/IG/1 ATFM QUESTIONNAIRE ON TASK 1.2.1

The purpose of this survey is to obtain information to know the current status of States and international organisations with regard to:

a) The methods for calculating airport and ATC capacity;

b) ATFM procedures for the following phases:
- ✓ Airport Strategic Phase,
- ✓ Airport Tactical Phase,
- ✓ Airspace Strategic Phase,
- ✓ Airspace Tactical Phase.

This information will enable the (SAM/IG) Implementation Group to meet its planning and harmonisation objectives.

Put an "X" on the corresponding answer. Please include your comments, if you so deem relevant. If necessary, attach additional sheets of paper. If applicable, send copies of the documents to the following email address: mail@lima.icao.int.

1. Does your administration currently have a methodology, basic or complex, for calculating airport capacity? If your answer is YES, please send a copy of the methodology to the following email address: mail@lima.icao.int.

☐ YES ☐ NO

If the answer is YES, please provide the available airport data on your main airports in the table below. Please note that, for purposes of this table:

Total Capacity = Airport Acceptance Rate (AAR) + Airport Departure Rate (ADR).

Airport name	Runway configuration	AAR VFR	AAR MVFR	AAR IFR	(ADR)	Total Capacity

Table 1

Comments

2. Does your administration currently have a methodology, basic or complex, for calculating en-route sector capacity? If your answer is YES, please send an electronic copy of the methodology to the following email address: mail@lima.icao.int.

☐ YES ☐ NO

If the answer is YES, please provide information about your main airports in the table below. Under the column "Time increments" please indicate whether sector capacity is calculated by 15-minute, 60-minute, or other time increments.

ACC	Sector name	Sector altitude	Sector capacity	Time increment

Table 2

Comments

3. Does your administration currently have procedures to support the following ATFM phases?

a) Airport Strategic Phase

☐ YES ☐ NO

b) Airport Tactical Phase

☐ YES ☐ NO

c) Airspace Strategic Phase

☐ YES ☐ NO

d) Airspace Tactical Phase

☐ YES ☐ NO

Comments

SAM/IG/1 ATMF QUESTIONNAIRE ON TASK 1.2.2

a) Flow management data processing and display:

1. Does your administration have a system to receive, process, and display flight plan data (FPL, RPL, etc.)?

☐ YES ☐ NO

2. Does your administration have a database that includes airspace information (for example, ACC, WGS 84 boundary coordinates, WGS 84 sector boundary coordinates, NAVAIDs, airways, special use airspace) and airport information (for example, runways, runway design, apron design, parking gate information)?

☐ YES ☐ NO

3. Does your administration have an ATFM system that displays air traffic?

☐ YES ☐ NO

4. Does your administration have a system that allows automatic or manual exchange of messages to support decision-making for ATFM (for example, SLOT assignment messages, slot adjustment messages, delay report messages, alternate route messages)?

☐ YES ☐ NO

5. Does your administration have a system to monitor the status of air navigation infrastructure?

☐ YES ☐ NO

6. Does your administration have a system to monitor and display airport acceptance rates (AAR) at major airports?

☐ YES ☐ NO

7. Does your administration have a system to monitor and display en-route sector capacity?

☐ YES ☐ NO

8. Does your administration have a system to monitor and display the aircraft mix that uses the airspace or airports?

☐ YES ☐ NO

b) Surveillance systems:

1. In the table below, list the type of surveillance systems used by the airspace structure of your administration.

ACC surveillance system	TMA surveillance system	Other surveillance system

Table 3

c) AIS/MAP:

1. In the following lines, list the AIS and MAP databases that your administration has to support ATFM.

2. Are they available in electronic format?

☐ YES ☐ NO

3. What is the updating cycle for AIS databases?

☐ UPDATED EVERY 28 DAYS ☐ UPDATED EVERY 56 DAYS

d) Meteorological information:

1. In the following lines, list the specific meteorological products and/or web sites that your administration has available to support ATFM.

e) Data for historical and statistical analysis:

1. In the following lines, list the type of databases your administration keeps in order to support the analysis of air traffic operations and meteorological activities.

f) Communication systems and processes to support CDM and inter-facility coordination:

1. List the types of communication systems that your operational units have with:

(a) other centralised ATFM organisations

(b) other FMUs, FMPs, and/or ATS units

(c) operators and airspace users

(d) airport authorities

(e) meteorological authorities

(f) aeronautical information services

(g) transmission of radar and ADS data to the ATFM centre

- - - - -

APPENDIX B

REPLY TO ATFM SURVEY
(SAMIG/2–Ref. LT 2/3A.5-SA722 of 8/9/2008)

STATES	ARG	BOL	BRA	CHI	COL	ECU	GUY (S/R)	FGU (S/R)	PAN	PAR	PER	SUR (S/R)	URU	VEN
TASK 1.2.1 General														
1. Does your administration currently have a method, basic or complex, to estimate airport capacity?	S*	N	S*	N	S*	N			N	N	N		N	N*
2. Does your administration currently have a method, basic or complex, to estimate en-route sector capacity?	N	N	S*	N	N	N			N	N	N		N*	N
3. Does your administration currently have procedures to support the following ATFM phases?														
a) Airport Strategic Phase	N	N	S*	N*	N*	N			N	S	N		N*	N
b) Airport Tactical Phase	N	N	S	S	S	N			N	N	N		S	N
c) Airspace Strategic Phase	N	N	S	N	N	N			N	S	N		N	N
d) Airspace Tactical Phase	N*	N	S	N	S	N			N*	S	N		S	N
TASK 1.2.2 a) Flow management data processing and display:														
1. Does your administration have a system to receive, process, and display flight plan data (FPL, RPL, etc.)?	S/R	S	S	S	S	S			S	S	S		S	S
2. Does your administration have a database that includes airspace information (for example, ACC, WGS 84 boundary coordinates, WGS 84 sector boundary coordinates, NAVAIDs, airways, special use airspace) and airport information (for example, runways, runway design, apron design, parking gate information)?	S/R	S	S	S	S	S			N*	S	P		N	S
3. Does your administration have an ATFM system that displays air traffic?	N	N	S	S	S	N			N	N	N		N	N
4. Does your administration have a system that allows automatic or manual exchange of messages to support decision-making for ATFM (for example, SLOT assignment messages, slot adjustment messages, delay report messages, alternate route messages)?	N	N	S	N	N	S			N	N	N		N	N
5. Does your administration have a system to monitor the	S/R	S	S	S	S/R	S			N	S	N		N	N

STATES	ARG	BOL	BRA	CHI	COL	ECU	GUY (S/R)	FGU (S/R)	PAN	PAR	PER	SUR (S/R)	URU	VEN
status of air navigation infrastructure?														
6. Does your administration have a system to monitor and display airport acceptance rates (AAR) at main airports?	N	S	S	N	N	S			N	N	N		N	N
7. Does your administration have a system to monitor and display en-route sector capacity?	N	S	S	N	N*	N			N	S	N		N	N
8. Does your administration have a system to monitor and display the aircraft mix that uses the airspace or airports?	N	N	S	N	N	S/R			N	N	N		N	N
TASK 1.2.2 b) Surveillance systems:														
In the table below, list the type of surveillance systems used by the airspace structure of your administration.	S*	N*	S*	S*	S*	S *			S*	N/A	S*		S*	S*
TASK 1.2.2 c) AIS/MAP:														
In the following lines, list the AIS and MAP databases that your administration has to support ATFM.	S*	S*	S*	N*	S*	S*			N*	S*	P*		N*	N
Are they available in electronic format?	S	N	S	S	N	S			N	S	N*		N	N
What is the updating cycle for AIS databases? 28 or 56 days?	S/R	S 56	S 28	S 28	S/R	S 56			S/R	S 56	N/A		S 28	S 56

S = Yes/Sí
* = Ver comentarios en original/ See comments in the original
N = No
P = Parcialmente/Partially
N/A = Not applicable/No aplicable
S/R = Without answer/ sin respuesta

STATES	ARG	BOL	BRA	CHI	COL	ECU	GUY (S/R)	FGU (S/R)	PAN	PAR	PER	SUR (S/R)	URU	VEN
TASK 1.2.2 d) Meteorological information:														
In the following lines, list the specific meteorological products and/or web sites that your administration has available to support ATFM.										S/R				
METAR	S	S*	S	S*	S	S			S		S		S	S
SPECI	S	S	S	S	S	S			S		S		S	N
TAF	S	S	S	S	S	S			S		S		S	S
SIGMET	S	S	S	N	S	S			S		S		S	S
ATIS	S	N	S	N	N	S			N		S		S	N
SATELLITE IMAGE	S	N	S	S	N	S			N		S		S	N
WAFS	S	S	S	N	S	S			N		S		S	S
ROUTE FORECAST	S	N	S	S	N	N			N		S		S	N
GAMET	S	S	S	S	N	N			N		S		S	N
UPPER WINDS	S	S	S	S	N	N			N		S		S	N
WEB CAMARA	N	N	N	S	N	N			N		N		N	N
METEOROLOGICAL RADAR	S	N	S	N	N	N			N		N		S	N
AIREP	S	S	S	N	N	N			N		N		S	S
AIRMET	S	S	S	N	N	N			N		N		S	N
TASK 1.2.2 e) Data for historical and statistical analysis:														
In the following lines, list the types of databases your administration keeps in order to support the analysis of air traffic operations and meteorological activities.	S*	S*	S*	S*	S*	S*			S*	S*	S*		S*	S*
TASK 1.2.2 f) Communication systems and processes to support CDM and inter-facility coordination:														
List the types of communication systems that your operational units have with:														
(a) other centralised ATFM organisations	N	S*	S*	S*	N	S*			N	N	N		N	S
(b) other FMUs, FMPs, and/or ATS units	N	S*	S*	S*	N	S*			S*	N	S*		S*	S
(c) operators and airspace users	N	S*	S*	S*	N	S*			S*	S*	S*		S*	S
(d) airport authorities	N	S*	S*	S*	S/R	S*			S*	S*	S*		S*	S
(e) meteorological authorities	N	S*	S*	S*	S*	S*			S*	S*	S*		S*	S
(f) aeronautical information services	N	S*	S*	S*	S*	S*			S*	N	S*		S*	S
(g) transmission of radar and ADS data to the ATFM centre	N	N/A	S*	N	S*	N			N		N		N	S

TABLE 1: REPLY TO ATFM SURVEY
(SAMIG/2–Ref. LT 2/3ª. 5 SA 722 of 8/9/2008)

QUESTIONS	RESULTS OBTAINED FROM REPLIES FROM 11 SAM STATES
TASK 1.2.1 General	
1. Does your administration currently have a method, basic or complex, to estimate airport capacity?	**YES**: 3 **NO**: 8
2. Does your administration currently have a method, basic or complex, to estimate en-route sector capacity?	**YES**: 1 **NO**: 10
3. Does your administration currently have procedures to support the following ATFM phases?	a) Airport Strategic Phase: **YES**: 2 / **NO**: 9 b) Airport Tactical Phase: **YES**: 4 / **NO**: 7 c) Airspace Strategic Phase: **YES**: 2 / **NO**: 9 d) Airspace Tactical Phase: **YES**: 4 / **NO**: 7
TASKA 1.2.2 a) Flow management data processing and display:	
1. Does your administration have a system to receive, process, and display flight plan data (FPL, RPL, etc.)?	**S/R**: 1 **YES**: 10
2. Does your administration have a database that includes airspace information (for example, ACC, WGS 84 boundary coordinates, WGS 84 sector boundary coordinates, NAVAIDs, airways, special use airspace) and airport information (for example, runways, runway design, apron design, parking gate information)?	**S/R**: 1 **YES**: 7 **NO**: 2 **P**: 1
3. Does your administration have an ATFM system that displays air traffic?	**YES**: 3 **NO**: 8

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QUESTIONS	RESULTS OBTAINED FROM REPLIES FROM 11 SAM STATES
5. Does your administration have a system that allows automatic or manual exchange of messages to support ATFM decision-making (for example, SLOT assignment messages, slot adjustment messages, delay report messages, alternate route messages)?	**YES**: 2 **NO**: 9
5. Does your administration have a system to monitor the status of air navigation infrastructure?	**S/R**: 2 **YES**: 5 **NO**: 4
6. Does your administration have a system to monitor and display airport acceptance rates (AAR) at the main airports?	**YES**: 3 **NO**: 8
7. Does your administration have a system to monitor and display en-route sector capacity?	**YES**: 3 **NO**: 8
8. Does your administration have a system to monitor and display the aircraft mix that uses the airspace or airports?	**YES**: 1 **NO**: 9 **S/R**: 1
TASK 1.2.2 b) Surveillance systems:	
In the table below, list the types of surveillance systems used by the airspace structure of your administration.	**YES**: 9 **NO**: 1 **N/A**: 1
TASK 1.2.2 c) AIS/MAP:	
1. In the following lines, list the AIS and MAP databases that your administration has to support ATFM.	**SI**: 6 **NO**: 4 **P**: 1
2. Are they available in electronic format?	**SI:** 5 **NO**: 6
3. What is the updating cycle for the AIS database? 28 or 56 days?	**SI**: 56: 4 **SI**: 28: 3 **S/R**: 3 **N/A**: 1
TASK 1.2.2 d) Meteorological information:	
In the following lines, list the specific	METAR: **YES**: 10 **NO**: 1 **S/R**: 3

QUESTIONS	RESULTS OBTAINED FROM REPLIES FROM 11 SAM STATES
meteorological products and/or web sites that your administration has available to support ATFM.	SPECI: **YES**: 9 **NO**: 2 **S/R**: 3 TAF: **YES**: 10 **NO**: 1 **S/R**: 3 SIGMET**:** **YES**: 9 **NO**: 2 **S/R**: 3 ATIS: **YES:** 6 **NO**: 6 **S/R**: 2 SATELLITE IMAGE: **YES**: 6 **NO**: 4 **S/R**: 3 WAFS: **YES**:9 **NO**: 4 **S/R**: 2 ROUTE FORECAST: **YES**: 6 **NO**: 6 **S/R**: 2 GAMET: **YES**: 6 **NO**: 5 **S/R**: 3 UPPER WIND: **YES**: 6 **NO**: 6 **S/R**: 3 WEB CAMERAS: **YES**: 1 **NO**: 10 **S/R**: 3 METEOROLOGICAL RADAR: **YES**: 3 **NO**: 8 **S/R**: 3 AIREP: **YES**: 5 **NO**: 6 **S/R**: 3 AIRMET: **YES**: 4 **NO**: 7 **S/R**: 3
TASK 1.2.2 e) Data for historical and statistical analysis:	
In the following lines, list the types of databases your administration keeps in order to support the analysis of air traffic operations and meteorological activities.	**YES**: 11
TASK 1.2.2 f) Communication systems and processes to support CDM and inter-facility coordination:	
List the types of communication systems that your operational units have with:	(a) other centralised ATFM organisations: **YES**: 5 **NO**: 6 (b) other FMUs, FMPs, and/or ATS units: **YES**: 8 **NO**: 3 (c) operators and airspace users: **YES**: 9 **NO**: 2 (d) airport authorities: **YES**: 9 **NO**: 1 **S/R**: 1 (e) meteorological authorities: **YES** 10 **NO**: 1 (f) aeronautical information services: **YES**: 10 **NO**: 1 (g) transmission of radar and ADS data to the ATFM centre: **YES**: 3 **NO**: 7 **N/A**: 1

- END -

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N/A = Not applicable/No aplicable
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APPENDIX C

ACTION PLAN FOR THE IMPLEMENTATION OF ATFM AT SAM AIRPORTS				
A: AIRPORT				
Task description	**Start**	**End**	**Responsible party (designate individual or organisation in charge)**	**Remarks**
1. Airport demand/capacity analysis	**Sep 2008**	**Apr 2010**		
1.1 Prepare ATFM survey	N/A	Aug 2008	Project RLA06/901 RO	Finalised
1.2 Send survey to the States of the Region	Aug 2008	SAM/IG/2	RO	Finalised
1.3 Analyse the methodology presented by Brazil for estimating airport capacity	June 2008	SAM/IG/2	ATFM/IG	Finalised and analyzed through WP/8, WP/16.
1.4 Send response to survey	N/A	SAM/IG/2	E	Finalised The Regional Office sent the survey to those States that had not yet done so.
1.5 Assess survey results	N/A	December 2008	ATFM/IG	The survey and information submitted by States was sent to the ATFM/TF Rapporteur
1.6 Course offered by Brazil on Airport Capacity Estimate	Mar 2009	Mar 2009	Brazil	Finalised The course was carried out from 23 – 27 March 2009, as planned
1.7 Development of the Methodology for the Calculation of Airport and Airspace Capacity in the SAM Region	Nov 2008	Jan 2009	Brazil and USA	Result to be presented at SAM/IG/4
1.8 The States estimate the airport capacity of their major airports	Jul 2009	SAM/IG/5	E	
1.9 Identify airports where the demand sometimes exceeds capacity, including, if necessary, simulations by the States	Aug 2009	SAM/IG/5	E	

ACTION PLAN FOR THE IMPLEMENTATION OF ATFM AT SAM AIRPORTS				
A: AIRPORT				
Task description	**Start**	**End**	**Responsible party (designate individual or organisation in charge)**	**Remarks**
1.10 Determine operational factors affecting airport demand and capacity in order to optimise the use of existing capacity, including simulations, if necessary	May 2009	SAM/IG/5	E	
1.11 Submit the conclusions on airport capacity	**N/A**	SAM/IG/5	E	
2. Coordination with the ATM community	**Sep 2008**	**Jun 2009**		
2.1 Present initial AIC model	SAM/IG/2	SAM/IG/2	ATFM/IG	Finalised
2.2 Publish initial AIC	SAM/IG/2	Next AIRAC date/2009 after SAM/IG/3	E	A reminder was sent to States for its publication.
2.3 Organise the ATFM community taking into account the CDM concept for ATFM implementation, and begin the relevant coordination		May 2009	E	
2.4 Inform the GREPECAS ATM Subgroup			N/A	
3. Infrastructure and database		**Aug 2008**		
3.1 Send the results of the survey developed by the hired expert to the Automation Group		Dec 2008		Valid This task has not yet been executed
3.2 Send to the Automation Group the information obtained by the expert hired on the data bases used in the Brazil, United States and Eurocontrol units	Jan 2009	SAM/IG/3		Valid This task has not yet been executed
3.3 Coordinate implementation activities with the Automation Group			ATFM/IG	Permanent
4. Policy, standards, and procedures			**Nov 2008**	
4.1 Hire expert to draft the manuals on ATFM measures for airports			N/A	Task included in 4.2

ACTION PLAN FOR THE IMPLEMENTATION OF ATFM AT SAM AIRPORTS				
A: AIRPORT				
Task description	**Start**	**End**	**Responsible party (designate individual or organisation in charge)**	**Remarks**
and FMU and FMP procedures				
4.2 Hiring of an expert for the elaboration of the ATFM Manual		February 2009	OR	Finalised. The task will be developed from 6 to 17 July 2009
4.3 Detailed development of ATFM Manual chapters	Dec 2008	SAM/IG/5	OR	Valid Approved partial draft, including ATFM concepts for airspace and airports. To acknowledge status of implementation at SAM/IG/4. The initial task shall be developed from 6 to 17 July 2009.
4.4 Present the model AIC Supplement		SAM/IG/5	ATFM/IG	
4.5 Approve the AIC Supplement		SAM/IG/5	ATFM/IG	
4.6 Publish the AIP Supplements		October 2010	E	
5. Training	**Sep 2008**			
5.1 Draft ATFM training plans		SAM/IG/4	E	
5.2 Train the team on decision-making at airports		Jun 2009	E	
5.3 Hire expert to draft Manual on the Introduction to ATFM for the ATM Community		SAM/IG/3	RLA/06/901	Valid This task has not been executed
5.4 Present and assess the Manual for the Introduction to ATFM for the ATM Community		SAM/IG/4	RLA/06/901	
5.5 Train the members of the ATM community in the CDM and ATFM concepts		TBD	E	

ACTION PLAN FOR THE IMPLEMENTATION OF ATFM AT SAM AIRPORTS				
A: AIRPORT				
Task description	**Start**	**End**	**Responsible party (designate individual or organisation in charge)**	**Remarks**
5.6 Train the staff in ATFM measures for airports		SAM/IG/4	E	
5.7 Monitor the training of the ATM community		Jul 2010	E	
6. Final implementation decision				
6.1 Review factors affecting the implementation decision		**SAM/IG/6**	ATFM/IG	
6.2 Declare the pre-operational implementation in the defined area			E	
6.3 Declare the final operational implementation in the defined area			E	
7. Monitor system performance	**SAM/IG/7**	**SAM/IG/8**		
7.1 Draft the ATFM post-implementation follow-up programme at airports	SAM/IG/6	SAM/IG/7	ATFM/IG	
7.2 Implement the ATFM post-implementation follow-up programme at airports	SAM/IG/7	TBD	SAM/IG/X	
Tentative pre-operational implementation date		**N/A**	**Oct 2010**	
Tentative definitive implementation date		**N/A**	**Dec 2010**	

Note:

E	States
SAM/IG	SAM Implementation Group
ATFM/IG	ATFM Implementation Group
OR	Regional Office

ACTION PLAN FOR ATFM IMPLEMENTATION IN THE SAM REGION			
B- AIRSPACE			
Task description	**Start**	**End**	**Responsible party (designate individual or office in charge)**
1. Airspace demand and capacity analysis			
1.1 Analyse the methodology to estimate airspace capacity presented by Brazil	Jun 2008	TBD	
1.2 Prepare an airspace demand survey	TBD	TBD	
1.4 Attend the course on Airspace Capacity Estimate	**TBD**	**TBD**	
1.5 The States estimate airspace capacity at the major airports	**TBD**	**TBD**	
1.6. Identify airspace sectors where demand sometimes exceeds capacity, including simulations by the States, if necessary	**TBD**	**TBD**	
1.7 Identify operational factors affecting airspace demand and capacity in order to optimise the use of existing capacity, including simulations if necessary	**TBD**	**TBD**	
1.8 Present the conclusions on airspace capacity	**TBD**		
2. Coordination with the ATM community	**Sep 2008**	**Jun 2009**	
2.1 The ATM community considers the implementation of ATFM in the airspace	Sep 2008	Jun 2009	
3. Infrastructure and database	**TBD**	**Dec 2013**	
3.1 Send requirements to the Automation Group, as stipulated in Appendix B of the ATFM CONOPS	TBD	TBD	
3.2 Coordinate implementation activities with the Automation Group	N/A	Dec 2013	
4. Policy, standards, and procedures	**TBD**	**Jun 2013**	
4.1 Develop ATFM policies, taking into account the objectives and principles established in the CAR/SAM ATFM CONOPS	**TBD**	**TBD**	
5. Training	**TBD**	**May 2013**	
5.1 Train the team on airspace data collection	Jun 2009	Jun 2009	
5.2 Train the staff on strategic ATFM measures for the airspace			
5.3 Develop ATFM plans and training material	**TBD**	TBD	

5.4 Train the personnel involved	TBD	TBD	
6. Final implementation decision	**N/A**	**Sep 2013**	
6.1 Analyse factors affecting the implementation decision	**N/A**	**TBD**	
6.2 Declare pre-operational implementation in the area defined	**N/A**	**TBD**	
6.3 Declare definitive operational implementation in the area defined	**N/A**	**TBD**	
7. Monitor system performance	**TBD**	**N/A**	
7.1 Draft ATFM post-implementation follow-up programme	TBD	Aug 2013	
7.2 Implement ATFM post-implementation follow-up programme	Dec 2013	N/A	
Tentative pre-operational implementation date	**N/A**	**Jul 2013**	
Tentative definitive implementation date	**N/A**	**Dec 2013**	

Agenda Item 6: Assessment of operational requirements in order to determine the implementation of communications and surveillance (CNS) capabilities improvement for en-route and terminal area operations

Improvements in the CNS systems

6.1 The Meeting took note that the *Guide for the improvement of CNS Systems to meet short- and medium-term operational requirements for en-route and terminal area operations* was circulated to SAM States. In this respect, many States of the Region replied to the consultation, indicating they had no comments to same.

6.2 Therefore, the Meeting considered that the Guide could be used by SAM States/Territories as guidance material to proceed with the improvements necessary to improve the CNS systems, with the aim of meeting short- and medium-term operational requirements for en route and terminal area operations.

6.3 Regarding the overall diagnosis made on the current status of conventional communications, navigation, and surveillance equipment in support of air navigation services, the Guide highlights the following:

a) The equipment installed in the existing AFTN systems has exceeded its useful life, its maintenance is economically unviable, and its availability, low.

b) The existing VHF equipment to support ground-air communications for ACC and APP tower services has exceeded its useful life, and presents maintenance problems due to lack of spare parts.

c) Lack of implementation of HF equipment to support international ground-air services at the ACCs. The existing HF equipment has largely exceeded its useful life, and has maintenance problems due to lack of spare parts.

d) There are not enough automated audio treatment systems (VCSS), in both ACCs and TWRs with sufficient volume of services to warrant the installation of this service.

e) The number of ATIS y VOLMETs specified in the FASID (Table CNS 2A) has not been installed.

f) VOR/DME and ILS equipment to support the air navigation services specified in FASID Table CNS 3 as well as domestic services, has maintenance problems since it has exceeded its useful life.

g) Lack of surveillance coverage. Many of the radar systems in the Region also have maintenance problems due to the obsolescence of their equipment.

h) National communication networks that support fixed communication services, access to ACC VHF remote stations, radar surveillance systems, and the monitoring of communication, navigation, and surveillance stations, require a network-type structure as stated in GREPECAS Conclusion 10/26 - *Development of national digital networks to enhance aeronautical communications*.

6.4 As regards the implementation of the new CNS systems in the Region, the Meeting took note of the following:

a) There is no exchange of flight plans in the conventional automated manner (4444), either through OLDI or AIDC.

b) ADS-C service is not provided in all oceanic FIRs.

c) The use of basic GNSS to support navigation services is not extensive.

d) ADS-B surveillance and multilateration are practically inexistent.

e) D-ATIS service is practically inexistent.

f) D-VOLMET service is inexistent.

g) The exchange of radar data between centres is practically inexistent.

6.5 In order to improve communications, navigation, and surveillance services, the Meeting took note that the Guide highlighted the need that the following short- (up to 2010) and medium-term (2011-2015) implementations, the following general activities had to be taken into account:

6.5.1 *Short term*

a) With a view to permit the harmonised implementation of all the new services, the IP aeronautical telecommunication network implementation should be the first to be implemented by States. ATN applications would be run over this network, being AMHS the first application to implement.

b) No improvement should be introduced to AFTN centres; all efforts should be geared to prompt AMHS implementation throughout the territory of each State. Those States that already have it should make the necessary arrangements to interconnect their MTAs using the REDDIG.

c) Those States that do not have Automated Audio Treatment Systems (VCSS) in ACCs and TWRs with a significant volume of services to be provided should do their best to implement them.

d) States that have Automated Processing Centres with OLDI should use this service between their national centres and make the necessary bilateral arrangements for its implementation between States.

e) States that do not have Automated Processing Centres should take the necessary steps to have, at least, OLDI and, if possible, AIDC facilities.

f) States with Oceanic FIRs should have HF aeronautical mobile service in the Oceanic FIR and make all efforts permitting or provide CPDLC service to FANS-equipped aircraft.

g) States should do their best to provide ATIS services at all international airports.

h) States should make efforts to provide these services in all the FIRs and ensure coverage of continental communications with VHF.

i) States should ensure the provision of ground navigation infrastructure, and make efforts to ensure radar coverage in the selected airspaces under their responsibility.

j) States with an Oceanic FIR should make their utmost to facilitate the provision of ADS-C services to FANS-equipped aircraft. *ADS-B /* multilateration. States that cannot provide radar coverage should make efforts to provide such coverage using ADS-B or multilateration.

k) States should make the necessary bilateral arrangements to share radar data with adjacent ACCs, in the modality that the technology installed in the respective centres permits, as specified in GREPECAS Conclusion 10/25 - *Coordination for the interconnection of digital networks*.

6.5.2 *Medium Term*

a) It is expected that, during this period, the AFTN will have practically disappeared from the Region and that all the States will have AMHS. Efforts should continue towards bilateral and multilateral integration between the AMHS(s) of each SAM State and inter-regional connectivity.

b) States should make efforts to have Automated Centres in all their ACCs. If they already have them and have OLDI facilities, then they should also have AIDC. If they do not have the centres, then they should acquire them with AIDC capabilities.

c) States that have an Oceanic FIR should provide CPDLC services at the corresponding ACCs, either through HFDL or third party services.

d) States that have decided to renew their existing VHF equipment should make the necessary efforts for its implementation.

e) States should start providing DATIS and DVOLMET services, replacing similar conventional services or implementing them where inexistent.

f) Regarding navigation equipment, they should start implementing GBAS systems.

g) All States responsible for an Oceanic FIR should provide ADS-C service to FANS-equipped aircraft. States should make sure that all the areas selected under their responsibility provide an efficient radar coverage and/or ADS-B/multilateration.

h) States should make efforts and enter into the necessary bilateral agreements to share radar data with adjacent Automated Centres, in Asterix categories 62 and 63.

i) States should implement surface movement guidance and control systems (A-SMGCS Levels III and IV) and the Traffic Information Service (TIS-B) in Level IV only at those airports with significant complexity and traffic.

6.6 The Meeting, taking into account the current general situation of the CNS systems, as well as the recommendations to improve them, that are presented in the *Guide for the improvement of CNS Systems to meet short- and medium-term operational requirements for en-route and terminal area operations*, considered that each SAM State should elaborate an action plan for the improvement of their CNS systems.

6.7 The implementation plan for CNS improvements should contain information on the current situation of the CNS systems in the State, indicating for each system its physical location (geographical coordinates), year of installation and actions programmed for its improvement. **Appendix A** to this part of the Report presents an action plan model to be completed by each State of the Region.

6.8 The CNS improvements' action plans to be elaborated by the States of the Region will permit becoming aware of the CNS systems current situation as a support to en route and terminal area navigation services, and of the short- and medium-term planned improvements towards facilitating the implementation of en route and terminal area navigation services. The implementation plans to be elaborated by the States of the Region should be presented at SAM/IG/4 meeting. In this respect, the following draft Conclusion is formulated:

CONCLUSION SAM/IG/3-5 - State implementation plans for improving CNS systems in the short and medium term

That, taking into account the guide for the improvement of CNS systems to meet the short- and medium-term operational requirements for en-route and terminal area operations developed by Project RLA/06/901 and reviewed by the SAM States/Territory (Appendix A to report on Agenda Item 5) and the action plan model for CNS improvements, in Appendix A to this part of the Report, SAM States draft an action plan for the improvement of CNS systems and, once completed, the plans be sent to the ICAO South American Regional Office before **28 August 2009**.

Interconnection of AMHS Systems in the SAM Region

6.9 The Meeting took note that the plans for the implementation of ATN ground-ground applications and the regional ATN router plans are defined in FASID Tables CNS 1Bb and CNS 1Ba, respectively, which were formulated through Conclusions 13/74 - *Proposal for Amendment of the Regional ATN Plan,* and 13/75 - *Request for information on plans for implementing ATN ground-air applications*, and reviewed at the sixth meeting of the GREPECAS ATM/CNS Subgroup (ATM/CNS/SG/6).

6.10 The Meeting examined the SAM CAAS (AMHS common addressing) regional mode AMHS addressing plan in the SAM Region, presented as **Appendix B** to this Agenda Item. In this regard, the Meeting deemed it convenient that the addressing plan should be taken under consideration by the States of the Region when implementing AMH systems.

6.11 The Meeting considered that, taking into account FASID Table CNS 1Bb specifications, the AMHS system to be installed in the SAM Region will use the IP protocol, initially the IPV4 version. The IPv4 addressing block to use is presented in Appendix D to SAM/IG/2-WP/19, and follows the scheme established at ATM/CNS/SG/6 meeting.

6.12 The Meeting took note of the AMHS systems interconnection trials that Argentina had carried out with Paraguay, as well as the plans of Argentina to carry out further AMHS tests with Brazil, Peru and Spain.

6.13 The Meeting took note of ICAO's letter to States AN 7/49.1-09/34 of 14 April 2009 related with management and updating of information on Air Traffic Services (ATS) Message Handling Services (AMHS) and the procedure for the inscription of a State representative that has implemented an AMHS system for him to be a user of the ATS message administrative centre (AMC). The letter indicates important and lesser procedure changes in AMHS addressing before the AMC use. In addition, it indicates that a training session will be carried out from 3 to 4 June 2009 at the Eurocontrol Air Navigation Services Institute (IANS) in Luxembourg. Information on the course is found in web page http://www.eurocontrol.int/anc.

6.14 The Meeting deemed it convenient that the national and regional implementation of AMHS and other ATN applications should be done within a network environment. At regional level, the REDDIG is available, and for interconnection with the CAR Region, there is the MEVA II/ REDDIG interconnection. At the national level, and in order to achieve a harmonised implementation of all the new services, the States should implement an aeronautical telecommunication network on which the various applications contained in the CNS/ATM concept would run, the AMHS being the first one. The type of network recommended for implementation is an IP network. Project RLA/06/901 submitted to the SAM/IG/2 meeting a guide for the implementation of national digital networks in IP protocol to support current and future aeronautical applications. SAM States should review and consider this guide as support material for the implementation of national networks.

6.15 The Meeting considered that for the interconnection of AMHS systems, SAM States have an AMHS addressing plan, an IPv4 addressing plan, and regional plans for the implementation of ground-ground applications and ATN routers, and a guide for the implementation of national digital networks in IP protocol to support current and future aeronautical applications.

6.16 In addition, that a review to the regional plans for the implementation of ground applications, the ATN routers and the Guidance for the implementation of national digital networks that use the IP protocol, to support current and future aeronautical applications.

6.17 With the revised information on the AMHS addressing structure, the suggested IPv4 addressing structure, the router implementation plans, the ATN ground-ground applications, the ATN architecture, the guide for the implementation of national digital networks in IP protocol to support current and future aeronautical applications, and the results of AMHS system interconnection trials in the Region, the Meeting agreed that it had all the necessary elements to prepare an AMHS system interconnection guide and start working on the interconnection of AMHS systems already installed in the Region.

6.18 In this regard, the Meeting considered that the Project would proceed to with a mission from an expert in AMHS systems, to elaborate a guide for the interconnection of AMHS systems. The result would be presented at the SAM/IG/4 meeting. In this regard, the following draft conclusion is formulated:

CONCLUSION SAMI/G/3-6- Interconnection of AMHS Systems in the SAM Region

That, in order to start implementing the interconnection of automated systems in the SAM Region:

a) the SAM States/Territory take note of the AMHS addressing structure in Appendix B to this Agenda Item, when implementing AMHS systems:

- review the router implementation plans, the ATN ground-ground applications in Appendix D to SAM/IG/2-WP/19 and present their results to the ICAO Regional Office by **29 May 2009**;

- review the Guide for the implementation of national digital networks in IP protocol to support current and future aeronautical applications in Appendix E to SAM/IG/2-WP/19 and present their comments by **30 June 2009**;

b) project RLA/06/901 elaborate a guide for the interconnection of AMHS system, by **31 July 2009**; and

c) SAM States, upon implementing the automated system interconnection, use the guidance documents prepared by project RLA/06/901.

Implementation of ADS-B trials

6.19 The Meeting examined the action plan for the implementation of ADS-B trials elaborated during SAM/IG/2 meeting, as well as the measurement parameters. In this respect, the Meeting took note that an ADS-B receiving station will be installed in Lima-Callao/Jorge Chavez International Airport, Peru, for the holding of trials. The station will remain installed at that location for one month, period when ADS-B data will be collected and then analyzed. The ADS-B receiving station will be installed at the end of April – beginning of May 2009. In addition, a workshop/seminar on the results of the ADS-B trials will be held from 3 to 5 June in Lima, Peru, at the facilities of the Corporación Peruana de Aeropuertos y Aviación Comercial (CORPAC) civil aviation training centre (CATC).

6.20 The Meeting took note that the ADS-B station, as well as the support to the trials and the workshop/seminar, was thanks to the collaboration of Thales, without any cost to the project.

6.21 The delegate from IATA requested to keep IATA informed on the activities of the ADS-B trial, in order to contribute with the necessary support to the same.

APPENDIX A

MODEL ACTION PLAN FOR THE IMPROVEMENT OF COMMUNICATIONS, NAVIGATION AND SURVEILLANCE SYSTEMS TO MEET SHORT- AND MEDIUM-TERM OPERATIONAL REQUIREMENTS FOR EN ROUTE AND TERMINAL AREA OPERATIONS

Instructions for the Elaboration of the Action Plan

The attached document is the model Action Plan for the Improvement of CNS Systems that each State is to complete.

The SAM States, upon elaborating the Action Plan, must only take into account the Sections indicated in the attached model.

The State, when drafting the Action Plan, will insert in Section 1 - *Objetive*, Section 2 – *Scope* and in Section 4 – *GREPECAS-approved regional plans and guidelines in the implementation of new ICAO CNS systems*, the same information as in the attached model Action Plan.

States, following the order in Section 3 – *Analysis and diagnosis of the current CNS situation*, and in Section 5 – *Improvements in the Communications, Navigation and Surveillance systems*, will complete the information indicated therein.

The purpose of the document's Section 4 is to present the plans and guidelines for the implementation of the new ICAO CNS systems, so it serves as guidance to States when completing Section 5 of the model Action Plan.

ATTACHMENT

MODEL ACTION PLAN FOR THE IMPROVEMENT OF COMMUNICATIONS, NAVIGATION AND SURVEILLANCE SYSTEMS TO MEET SHORT- AND MEDIUM-TERM OPERATIONAL REQUIREMENTS FOR EN ROUTE AND TERMINAL AREA OPERATIONS

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1. Objective

1.1 This action plan describes the actions to take for the improvement of CNS systems, with the aim of supporting short- and medium-term en route and terminal area operations, within the framework of the Air Navigation Global Plan.

1.2 To comply with this objective, an analysis and diagnosis has been made of the CNS systems currently supporting short- and medium-term en route and terminal area operational requirements.

1.3 Taking into account the status of operation of the CNS systems supporting short- and medium-term en route and terminal area operational requirements, as well as the new regional CNS systems implementation plans approved by GREPECAS, following are the action plans for the improvement of CNS systems in support of en route and terminal area operations.

2. Scope

2.1 This document takes into consideration the action plans for short- and medium-term implementation, respectively, up to 2010 and between 2011 and 2015, as indicated in the guidelines contained in the Air Navigation Global Plan.

3. Analysis and diagnosis of the current CNS situation

3.1 Communications

3.1.1 Aeronautical Fixed Service

Conventional services

3.1.1.1 States having AFTN systems implemented, must describe the diagnosis of the AFTN system, indicating the AFTN network's configuration and its date of installation.

3.1.1.2 States having telephone systems (PBX) implemented, as well as VHF frequency selection systems (VCS), will present information related with their configuration and date of installation.

Services under the ICAO CNS/ATM concept

3.1.1.3 States must indicate whether thay have ATN ground applications implemented, such as AMHS and AIDC. In this regard, indicate configuration and date of implementation.

3.1.2 Aeronautical Mobile Service

Conventional services

3.1.2.1 States will prepare a list with all ground-air VHF stations installed, indicating the frequency of the equipment, date of installation and geographical coordinates of the stations. As reference use can be made of List No. 3 - *Record of VHF Frequency assignments in the band 117.975-137.000 MHz*, found in the SAM Regional Office Web page (user: cns_user; password: apass4u), or in the format used domestically to register A/T VHF stations, but that has the information requested (site of installation, location coordinates, date of installation and coverage).

Services under the ICAO CNS/ATM concept

3.1.2.2 States will indicate whether they have implemented systems such as CPDLC, VDL, HFDL and VDL.

3.1.3 **Radiobroadcasting service**

3.1.3.1 States will indicate the radiobroadcasting services implemented (ATIS, D-ATIS, VOLMET), including their location and year of installation.

3.1.4 **National communications network for the transport of air navigation services**

3.1.4.1 Under this section, States will describe the domestic network's configuration, whether it is owned by the aeronautical administration, or leased.

3.2 **Navigation Service**

Conventional services

3.2.1 States must make a complete list of all radio navigation aids installed, indicating the site of installation, coordinates, date of installation and coverage. As reference, use can be made of List No. 1 - *List of Facilities Operating on Frequencies in the LF/MF Band (190-1750 kHz)* and List No. 2 - *Record of VHF Frequency Assignments to Caribbean and South American VOR and ILS Radio Navigation Aids*, found in the SAM Regional Office Web page (user: cns_user; password: apass4u), or in the format used domestically to register A/T VHF stations, but that has the information requested (site of installation, location coordinates, date of installation and coverage).

Services under the ICAO CNS/ATM concept

3.2.2 States must indicate if they have installed GBAS systems, or if they have regulations on the use of ABAS.

3.3 **Surveillance Service**

Conventional services

3.3.1 States must make a complete list of all surveillance equipment installed, indicating the site of installation, coordinates, date of installation and coverage.

Services under the ICAO CNS/ATM concept

3.3.2 States must indicate whether they have implemented ADS-C systems, multilateration or ADS-B.

4. GREPECAS-approved regional plans and guidelines in the implementation of new ICAO CNS systems

4.1 Background

4.1.1 This section will describe the regional plans and strategies for the new CNS systems, with the aim that States take them under consideration when presenting the action plans for CNS improvements pertaining to Chapter 4 of this document.

4.2 Communications

4.2.1 Aeronautical Fixed Service

4.2.1.1 For the implementation of ATN and of ATN ground applications in the Region, there is an ATN router plan and an ATN ground applications plan.

4.2.1.2 The ATN router plan contains information on the planning of routers, indicating the following for eache: administration and location where the router is found, type of router, connections correponding to the router, speed of the links, communications means and date of implementation..

4.2.1.3 The ATN router plan for the SAM Region (Table CNS 1Ba) is shown in Appendix D to SAM I/G/3-WP/19.

4.2.1.4 The ATN ground applications implementation plan for the SAM Region takes under consideration AMHS and ADC implementation. The plan contains the administration and location where the application is found, the type of ground application to implement, the sites to interconnect, the standard to use and the date of implementation. The ATN ground application plan is shown in Appendix D to SAM/IG/2-WP/19.

4.2.2 Aeronautical Mobile Service

4.2.2.1 For the implementation of communications systems in support of the aeronautical mobile service, GREPECAS approved an *Activity plan for the planning and implementation of air-ground data links*. The Plan contains guidelines for States before starting with the implementation of ground-air communications data link systems.

SAM activitiy plan for the planning and implementation of air-ground data links

a) Participate in air-ground data link seminars and workshops.

b) Review and update the air-ground data link regional plan (FASID Table CNS 2A) to obtain communications benefits by improving safety, efficiency and capacity, through the reduction of voice communications and implementing automation processes to comply with the operational requirements in coordination and harmony with the ATM global system.

c) Evaluate the capacity and modernization need of the control centres and aircraft fleed operating in the respective FIR and airspace, to implement air-ground data links in conformity with operational requirements, ICAO SARPs and guidelines, and incorporating the respective implementaion planning.

d) Establish and participate in a trial and demonstration programme on air-ground data link systems and applications.

e) Study and evaluate the arrangements made by other States/International organizations for the implementation of data links, by establishing multinational cooperation mechanisms.

f) In conformity with the global roadmap, establish a CAR/SAM programme for the evolutionary implementation of air-ground data links, ensuring regional and interregional interoperability to meet global ATM system requirements in a coordinate, harmonious and seamless manner.

g) Undertake and monitor investigations and developments on communications technology, as well as follow-up on ICAO SARPs and guidelines on the future evolution of data links and its services.

h) These activities should be developed to carry out the below indicated air-ground applications programme.

Regional programme for the implemenation of air-ground data links

4.2.2.2 The regional programme for the implementation of air-ground data links contains information of the implementation of air ground data links in the immediate (2009-2011), medium (2011-2015) and long term (2015 and onwards).

CAR/SAM PROGRAMME FOR THE IMPLEMENTATION OF AIR-GROUND DATA LINKS		
TERM	**GOALS**	**SERVICES**
Immediate (2009-2011)	Implement ACARS and FANS based data link services and start the use of VDL-Mode 2 and HFDL in confirmity with ICAO SARPs and guidelines.	Maximize the use of: - pre-departure dispatch; - oceanic dispatch; - D-ATIS; - other flight and routine information messages; and - aircraft automatic position reporting.
Medium (2011–2015)		- more complex information related with security, including ATC dispatch, can be exchanged.
Long (after 2015)	Implement VDL data links in accordance with its future evolution and in confirmity with the new ICAO SARPs and guidelines.	- The use will include descending flight parameter link, for use of the ATM system; and - ascending traffic data link, to improve awareness at the pilot cabin.

4.3 **Navigation Service**

4.3.1 For the navigation service, a *CAR/SAM Strategy for the Introduction and Application of Non Visual Aids for Approach, Landing and Departure* , as indicated hereunder:

a) maintain the ILS as the ICAO standard precision approach and landing system as long as necessary and as long as it remains operationally acceptable and economically beneficial, doing everything possible to not deny access to airports to aircraft equipped only with ILS;

b) implement GNSS with augmentation as required for APV and Category I operations where operationally required and technically feasible and economically beneficial, taking into account GNSS evolution;

c) promote the development and use of a multi-modal airborne landing capability;

d) promote the use of APV operations, particularly those using GNSS vertical guidance, to enhance safety and accessibility; and

e) identify and resolve operational and technical feasibility issues for GNSS with ground-based augmentation system (GBAS) to support Category II and III operations~~,~~ Implement GNSS for Category II and III operations where operationally required and economically beneficial.

Guidelines for transition to satellite navigation systems in the CAR/SAM regions

4.3.2 GREPECAS also elaborated guidelines for the transition to CAR/SAM satellite navigation, as follows:

4.3.3 GNSS should be introduced in an evolutionary manner, with improvements in GNSS capability generating increasing benefits, and culminating in GNSS supporting all phases of flight. As GNSS evolves, the planning for the removal of ground-based navigation aids should take account of the issues described below.

4.3.4 the ground infrastructure for current navigation systems must remain available during the transition period.

a) States/regions can consider segregating traffic according to navigation capability and granting preferred routes to aircraft with better navigation performance where this can be done without reducing airspace capacity;

b) before any existing ground infrastructure is considered for removal, users shall be given reasonable transition time to allow them to equip with GNSS to attain equivalent navigation service;

c) as GNSS is introduced for enroute operation, States/regions should coordinate to ensure that harmonized separation standards and procedures are developed and introduced concurrently in all flight information regions along major traffic flows to allow for a seamless transition to GNSS-based navigation;

d) In planning the transition to GNSS, the following issues must be considered:

- maintaining or improving the current level of safety;
- schedule for provision and/or adoption of a GNSS service, including aircraft and operator approval processes;
- extent of existing ground-based radio navigation services;
- strategy for transition schedule to GNSS capability (i.e. benefits-driven or mandatory);
- appropriate level of user equipage with GNSS capability;
- provision of other air traffic services (i.e. surveillance and communications);
- density of traffic/frequency of operations;
- mitigation of risks associated with radio frequency interference failures and ionospheric issues;
- design and implementation of procedures; and
- over-all economics and lead times to introduce aircraft avionics requirements.

4.4 **Surveillance Service**

4.4.1 The surveillance systems implementation plans are found in FASID Table CNS 4A. The planning for the new surveillance systems is in the surveillance systems implementation guide presented at the sixth meeting of the ATM/CNS Subgroup (ATM/CNS/SG/6).

4.4.2 Following is a description of the surveillance systems implementation guide.

Surveillance infrastructure evolution

En-Route and TMA airspace

4.4.3 Independent Surveillance, in the form of Primary Surveillance Radar still be used in En-Route Surveillance and Terminal Maneuvering Area (TMA) based on local country specific security requirements.

Short term (until 2011)

4.4.4 From 2008 to 2011, co-operative surveillance, in the form of SSR and SSR Mode S, will still be the main means of surveillance and will be extensively used for air traffic surveillance by civil agencies for TMA and En-Route services within coverage of (ground based) interrogator station(s). Implementation of monopulse SSR, adaptable to Mode S, in medium- and high-traffic en route and terminal areas will continue. Use of ADS-B (ES Mode S receivers) will begin to provide surveillance for en-route and terminal areas not covered with radar and to strengthen surveillance in areas covered with SSR Modes A/C and S.

Medium term (2011-2015)

4.4.5 SSR Mode S elementary surveillance will be implemented from 2010 onwards in high density TMAs in order to improve secondary radar performances. Since there will still exist legacy aircrafts that will not be able to reply on mode S, a mixed mode interrogation will be required up to 2015.

4.4.6 Ground implementation for ADS-B (based on ES Mode S receivers) will increase from 2011 onwards to fill en route and terminal areas not covered with radar and to strengthen surveillance in areas covered with SSR Modes A/C and S.

4.4.7 Depending on the percentage of ADS-B equipped aircrafts, wide area multilateration (WAM) implementation should be considered as a possible transition path to ADS-B environment in a shorter timeframe.

4.4.8 ADS-C surveillance should be operationally used in all oceanic and remote airspace associated with FANS 1/A capacities

4.4.9 Surveillance Data Processing and Distribution systems based on surveillance server technology will have to be progressively upgraded, in order to merge legacy radar data information contained in the ADD and/or from Multilateration position calculations and promote data sharing between States using TCP/IP patterns.

4.4.10 Each State/Territory/Organization should investigate and report their Administration’s policy in respect to the ADS-B data sharing with their neighbors and from cooperative goals.

4.4.11 The ADS-B data sharing plan should be based on selecting centres by pairs and analyzing the benefits and formulating proposals for the ADS-B use for each pair of centre/city with the purpose to improve the surveillance capacity.

4.4.12 To support the ADS-C and ADS-B regional plan, the States/Territories/International organizations, as well as the entity representing the airspace users, should organized and provide the following information; a focal point of contact, its respective implementation plan, including a time-table, and information on its air-ground communications and automation systems.

4.4.13 The ADS-B data links technology that will be used for the Mode S 1,090 MHz extended squitter (1090 ES). ADS-B data sharing could be initiated.

4.4.14 SSR Mode A/C and SSR Mode S will continue to be the main surveillance elements for approach, en route, and terminal areas.

Long term (until 2015-2025)

4.4.15 The majority of the SSR and SSR Mode S systems currently installed would be at the end of their operational life by 2015. SSR Mode A/C radars that have completed their life cycle by that time will not be replaced. Continuation of the ADS-B use with the 1090 ES technique and the planning initiation for the ADS-B implementation by new data links to satisfy the ATM global system requirements will fully replace those decommissioned SSRs.

Aerodrome Operations

Short term (until 2011)

4.4.16 The main technology for calculating the position of mobiles (both aircraft and vehicles) will be Surface Movement (primary) Radar.

4.4.17 Implementation of multilateration will gradually increase, where aircraft respond to SSR Mode A/C or SSR Mode S queries.

Medium term (2011-2015)

4.4.18 A-SMGCS Level I/II will provide the benefits at the aerodrome and additional information may be required by the ground systems. The most effective means of achieving this would be via ADS-B, since aircraft will already be equipped and there will be a cost-effective upgrade path for the Multilateration ground stations, although there may be an impact on the avionics. Although many Multilateration systems are configured with their own data fusion trackers as standard, a possible upgrade to existing SDPDs to support Aerodrome operations will be required.

Long term (until 2015-2025)

4.4.19 The introduction of A-SMGCS Levels III/IV at selected aerodromes will require aircrew to be presented, with an airport map and other mobiles for situational awareness and possible conflict prediction tools in the aircraft. Where airports foresee a benefit from these kinds of applications then a TIS-B service may be required to ensure a complete and consistent airport situation picture.

Aircraft systems

Short term (until 2011)

4.4.20 In accordance with ICAO requirements, all aircraft flying within CAR/SAM controlled airspace are required to be equipped with a pressure altitude reporting device. It is not foreseen that there will be significant changes for aircraft systems prior to 2011 on that matter.

4.4.21 The proportions of equipped aircrafts are also critical for the ADS-C and ADS-B deployment, for which it is required that ANSP and aircraft users periodically coordinate, al least, the following information: number of equipped aircrafts operating in the concern airspace, number and name of the airlines that have equipped aircrafts for ADS-C and ADS-B, type of equipped aircrafts, categorization of the accuracy/integrity data available in the aircrafts.

5. Improvements in the Communications, Navigation and Surveillance systems

5.1 Background

5.1.1 In this section, States will indicate all plans scheduled for the improvements in the services indicated hereunder. In this respect, States will have to add estimated dates for their implementation.

5.2 Communications

5.2.1 Aeronautical Fixed Service

5.2.1.1 *Conventional services*

5.2.1.2 *Services under the ICAO CNS/ATM concept*

5.2.2 Aeronautical Mobile Service

5.2.2.1 *Conventional services*

5.2.2.2 *Services under the ICAO CNS/ATM concept*

5.2.3 Radiobroadcasting Services

5.2.4 National communications network for the transport of air navigation services

5.3 Navigation

5.3.1 *Conventional services*

5.3.2 *Services under the ICAO CNS/ATM concept*

5.4 Surveillance

5.4.1 *Conventional services*

5.4.2 *Services under the ICAO CNS/ATM concept*

APPENDIX B

SAM REGION AMHS CAAS ADDRESSING SUGGESTED VALUES

STATE	AMHS ADDRESSING SPECIFICATICIONS					
	ATTRIBUTION NAME STATES (C)	ATTRIBUTION NAME ADM (A)	NAME PRMD (P)	ORGANIZATION NAME (O) *	ORGANIZATIONAL UNIT NAME (OUI)	COMMON NAME (CN)
ARGENTINA	XX	ICAO	SA	SAEZ SAVC SACO SAME SARE	All four letters indicated in ICAO Doc 7910	AFTN address 8 letter
BOLIVIA	XX	ICAO	BOLIVIA	SLLF	Id	Id
BRAZIL	XX	ICAO	SB	SBEG SBCT SBRF SBBR	Id	Id
CHILE	XX	ICAO	CHILE	SCEZ	Id	Id
COLOMBIA	XX	ICAO	COLOMBIA	SKED	Id	Id
ECUADOR	XX	ICAO	ECUADOR	SEGU	Id	Id
FRENCH GUIANA	XX	ICAO	FRENCH GUIANA	SOCA	Id	Id
GUYANA	XX	ICAO	GUYANA	SYCJ	Id	Id
PANAMA	XX	ICAO	PANAMA	MPTO	Id	Id
PARAGUAY	XX	ICAO	SG	SGAS	Id	Id
PERU	XX	ICAO	PERU	SPLI	Id	Id
SURINAME	XX	ICAO	SURINAME	SMPM	Id	Id
URUGUAY	XX	ICAO	URUGUAY	SUEO	Id	Id
VENEZUELA	XX	ICAO	VENEZUELA	SVZM	Id	

Agenda Item 7: Operational implementation of new ATM automated systems and integration of the existing systems

7.1 The meeting reviewed the Memorandum of Understanding for the interconnection of automated systems of States/Territories in the ICAO SAM Region, requested to be prepared during the SAM/IG/2 Meeting. The Memorandum represents guidance for States of the SAM Region interested in holding bilateral meetings. The document contains the necessary technical, operational, administrative and financial matters to perform the interconnection. The referred document is presented in **Appendix A** to this part of the report.

7.2 The meeting considered that States of the SAM Region could prepare specific implementation plan for interconnection of automated systems, taking into account the Memorandum of Understanding, as well as other documentation prepared on this respect by GREPECAS and other ICAO Regional Projects, such as the Interface control Document (ICD) (CAR/SAM ICD), the Interface control system document (SICD), the initial interconnection regional plan of automated systems in ACCs, and the preliminary requirements document which must have automated systems (SSS).

7.3 The meeting noted that agreements had been established between Brazil and Venezuela for the implementation of the flight plans interconnection and radar data, through the REDDIG, estimating its implementation by the end of June 2009. Also, the meeting noted that the interconnection of radar systems and flight plans between Colombia and Panama, was being implemented.

7.4 The meeting amended the action plan prepared during the SAM/IG/1 Meeting, and the same is presented as **Appendix B** to this part of the report.

7.5 The meeting considered that, for the implementation of specific plans, the amended action plan should be taken into consideration, estimating that during the last years, several States of the Region had renewed their automated systems, the Interface Control System Document (SICD), which contains equipment and interfaces of equipment to be interconnected, required an amendment. To this end, and taking into account all the aspects aforementioned, the Meeting formulated the following conclusions:

Conclusion SAM/IG/3-7 Updating of SCID Document

In order to update the SICD document, prepared in 2007:

a) States of the SAM Region included in the SICD, are encouraged to review and update the information contained in the document

b) Any State of the Region having automated systems not included in the SICD, should send the information to the ICAO South American Regional Office; and

c) The information requested in a) and b) above, should be sent to the ICAO South American Regional Office, not later than 29 May 2009.

Conclusion SAM/IG/3-8 Preparation of specific implementation plans for the interconnection of automated systems.

That States of the SAM Region start the development of specific plans for the implementation of automated systems interconnection, considering the implementation dates indicated in Regional Interconnection Plan for Automated Systems in adjacent ACCs, specified in **Appendix B** of this part of the Report, and information contained in the following documentation:

a) Memorandum of Understanding for the implementation of automated systems interconnection between two States having adjacent ACCs, Interface Control Document (ICD) for data communication between ATS dependencies in Caribbean and South American Regions (CAR/SAM ICD).

b) Interface control document (ICD) for data communications between ATS units in the Caribbean and South American Regions (CAR/SAM ICD).

c) System Interface Control Document (SICD)

d) Regional interconnection initial plan for ACC automated systems.

e) Preliminary reference system/subsystem specification for the air traffic control automation system (SSS).

Amendment 1 to Document 4444

7.6 When analyzing the guidelines contained in amendment 1 to document PANS-ATM related to flight plans, which nature and extent is to update the flight plan form in order to meet the aircraft needs with advanced capacity, and the evolutionary requirements of air traffic management automated systems, taking into account its compatibility with existing systems, human factors and the aspects related with costs and transition, the meeting considered necessary that the project prepare an initial plan for the implementation of referred amendment and to be presented during SAM/IG/4. The initial plan would allow States of the Region to count with an initial strategy for the implementation of the amendment. In this respect, the Meeting considered that the initial plan would be developed by an expert in automation systems, through project RLA/06/901.

Transmission and reception of EST messages

7.7 The Meeting, when analyzing the problem related to transmission and reception of messages of EST type and of flight plans distribution recurrent to all ACC involved, presented by Uruguayan delegate, considered that this matter was related to operative items and, consequently should be analyzed with the states involved.

7.8 The delegate from Brazil, on this respect informed that in case of Brazil, contacts to solve the tactical operational problems should be made through CGNA.

7.9 The meeting took note that for the month of September, a multilateral meeting will be held in Lima among Argentina, Bolivia Brazil, Paraguay and Uruguay. Among other aspects, matters related with transmission and reception of ATS messages, and distribution of repetitive flight plans will be dealt with. To this end, participating States were encouraged to include staff from the CNS area.

Automation Requirements by States based in SSS document

7.10 The Meeting analyzed charts presented by Uruguay which intend to identify automation requirements identified in document SSS with automated systems that have the States of the Region. In this respect, the Meeting considered that said documentation will be useful so as to analyze the automation requirements among States.

APPENDIX A

MEMORANDUM OF UNDERSTANDING FOR THE INTERCONNECTION OF AUTOMATED SYSTEMS OF STATES/TERRITORIES OF THE ICAO SAM REGION

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1. Section 1 – Introduction and Purpose

1.1 Introduction

1.1.1 GREPECAS/15, taking into account the impact that operational errors in the ATC coordination loop between adjacent ACCs have on safety, considered, in its Conclusion 15/36, that "CAR/SAM States/Territories/International Organisations (should) gradually implement the interface for the exchange of data between ATC units (AIDC);" and that "ICAO (should) coordinate, provide assistance, and monitor the implementation of these corrective measures."

1.1.2 After analysing the problem, it was concluded that the solution was based on the intense use of CNS/ATM technologies, in accordance with ICAO recommendations, especially the ones related to the interconnection of automated systems, as described in Document 4444-PANS/ATM, Section 8.1.6: "States should foresee the automated exchange of coordination data regarding the aircraft which are provided ATS surveillance services, based on regional air navigation agreements, and should establish automated coordination procedures."

1.1.3 In this sense, through Projects RLA/98/003 and RLA /06/901, studies were carried out in order to have a full view on this topic, including obstacles and necessary actions, as well as the implementation strategy.

1.1.4 The documents prepared are described in Annexes 1, 2, and 3 to the Appendix to this Memorandum.

1.1.5 The body of this document consists of ten (10) sections and one (1) appendix. The content of the sections and the appendix is summarised below:

a) Section 1 – Brief overview and purpose statement;

b) Section 2 – Describes the basic principles driving the drafting of this document;

c) Section 3 – Considers the cases to which this Memorandum applies;

d) Section 4 – Describes the version control process;

e) Section 5 – Lists the laws considered;

f) Section 6 – Establishes criteria and restrictions for the use of information shared between two countries;

g) Section 7 – Presents the operational aspects that must be taken into account for the interconnection of automated systems;

h) Section 8 – Presents the technical aspects that must be considered for the interconnection of automated systems;

i) Section 9 - Presents the administrative aspects that must be considered for the interconnection of automated systems;

j) Section 10 - Presents the financial aspects that must be considered for the interconnection of automated systems;

k) Appendix 1 – Technical and Operational Agreement.

1.2 **Purpose**

1.2.1 The goal of this MoU is to provide the planning for the interconnection of automated systems in the SAM Region, establishing standard procedures covering operational, technical, administrative, and financial considerations.

2. **Section 2 – Principles**

2.1 In preparing this document, the following aspects have been taken into account:

a) This Memorandum is a guide for SAM States to enter into bilateral agreements; and

b) This document takes into account the aspects contained in the documents dealing with the interconnection of automated systems prepared under Projects RLA/98/003 and RLA 06/901, as well as the recommendations and documentation prepared by GREPECAS.

3. **Section 3 – Application**

3.1 This document applies to all SAM States that have automated air traffic control systems and that wish to interconnect them.

3.2 This document applies only to the interconnection of automated systems between two (2) States.

4. **Section – Organisation**

4.1 This is a document through which the participating States will agree, as necessary, to review or modify its details.

4.2 Revised versions of this Memorandum or changes to its paragraphs will be coordinated by the participating States.

5. **Section 5 – References**

5.1 This Memorandum follows ICAO recommendations contained in the following documents:

a) Annex 11 to the Convention on International Civil Aviation;

b) Doc 4444;

c) Doc 7030;

d) Doc 9426;

e) Doc 9694;

f) Doc 9880 part II (AIDC);

g) RLA/98/003 Project Document;

h) RLA/06/901 Project Document; and

i) Final reports of the SAM/IG/1 and SAM/IG/2 meetings.

6. **Section 6 – Confidentiality**

6.1 Each participating State must implement all the necessary measures to ensure the safety, integrity, and confidentiality of the information.

6.2 This data may only be disclosed to other organisations not included in this Memorandum if previously authorised by the participating States.

7. **Section 7 – Operational Aspects**

7.1 The application of this Memorandum may entail the need to make adjustments to the Operational Agreements already existing among the States.

7.2 The Administrations agree to instruct the personnel of the involved ACCs on the relevant parts of this MOU.

7.3 Automated hand-off shall be used as a priority, through transmission of the necessary data between automated systems, in accordance with the specifications set forth in the Appendix to this Memorandum of Understanding.

7.4 However, the hand-off may be carried out by using other means of communication in such cases where automatic hand-off is not possible.

8. **Section 8 – Technical Aspects**

8.1 The necessary technical considerations for States to determine the interconnection scenarios, the implementation strategy, the implementation of the solution, the operation supervision, and the staff training aspects that will best address their needs are contained in Section 6 of the Appendix to this Memorandum.

9. **Section 9 – Administrative Aspects**

9.1 In order to orderly manage the interconnection solution adopted, the participating States agree to create an administrative structure based on an Interconnection Management Committee, which duties, detailed composition, and activities are described in Section 7 of the Appendix to this Memorandum.

9.2 The States must appoint their representatives, members of their respective groups, who will be part of the basic structure of the cited Committee.

9.3 The States must select a forum to discuss outstanding cases and to settle potential disputes.

9.4 This Memorandum has a continuous nature, and may be interrupted at any time by mutual agreement of the Parties involved.

10. **Section 10 – Financial Aspects**

10.1 The participating States, as independent administrations, will be responsible for any financial obligation to cover direct or indirect expenses related to the fulfilment of this Memorandum, including those related to the purchase of equipment, spare parts, training of technical and operational personnel, communication lines, and others.

10.2 Each State will be responsible for paying its share of any cost related to upgrades to the REDDIG to support traffic increase, in accordance with the guidelines of the REDDIG Administration.

10.3 The Parties to this Memorandum understand that they will not commit to any action that could result in a financial obligation to the other Parties, without first obtaining a written consent of all the other parties involved.

10.4 The States may establish financial mechanisms to carry out the interconnection through, for example, ICAO Technical Cooperation Projects.

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APPENDIX TO THE MEMORANDUM OF UNDERSTANIDNG

TECHNICAL AND OPERATIONAL AGREEMENT FOR THE INTERCONNECTION OF THE AUTOMATED SYSTEMS OF THE STATES/TERRITORIES OF THE ICAO SAM REGION

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1. **Purpose**

1.1 To provide details on the technical, operational, and administrative aspects of the Memorandum of Understanding that are necessary for the interconnection of automated systems in the SAM Region.

2. **Summary**

2.1 ICAO Projects RLA/98/003 and RLA/06/901 defined the resources for conducting studies in order to have a full view of the interconnection of automated systems, including the obstacles and necessary actions, as well as the implementation strategy.

2.2 The work carried out was the following:

a) Drafting of the Initial Action Plan – July 2006;

b) Brazil-Venezuela Concept Trial – September 2006;

c) Data Collection– Phase 1 – survey to countries – current interfaces;

d) Data Collection– Phase 2 – missions to the countries – details of interfaces – 2007

- 1st mission: Peru, Ecuador, and Venezuela – September 2007,
- 2nd mission: Colombia, Panama, and COCESNA – October 2007, and
- 3rd mission: Chile, Argentina, and Uruguay - November 2007.

e) Drafting of the Interconnection Plan– February 2008;

f) Drafting of the SICD (System Interface Control Document) – March 2008; and

g) Drafting of the SSS (System Subsystem Specification) document – September 2008.

2.3 The products generated contain, in summary, the following aspects:

a) SICD: contains all the data collected in the SAM States that have automated systems, as well as descriptions of their interfaces, thereby providing an overview of the current status and the recommendations for the adoption of measures necessary for their interconnection;

b) Interconnection Plan: contains the objectives, concepts, strategies, and actions necessary to address the operational requirements related to traffic hand-off between adjacent ACCs in the SAM Region; and

c) SSS: presents the requirements, particularly the mandatory ones, for ACC automated systems, to be used as reference for future implementations of new automated air traffic control systems and their upgrades, when necessary.

2.4 The SICD, the Interconnection Plan, and the SSS were presented for analysis and approval at the following events:

a) Interconnection Plan and SICD:

- Project RLA 06/901 – First Meeting of the SAM Implementation Group (SAM IG/1) Regional Project RLA/06/901, Peru, April 2007.
- Sixth Meeting of the GREPECAS ATM/CNS Subgroup, Dominican Republic, July 2008.
- Seminar/Workshop on ATM Automation, Brazil, June 2008.

b) SSS:

Project RLA/06/901 - Second Meeting of the SAM Implementation Group (SAM/IG/2), Peru, November 2008.

3. **Reference**

3.1 This Agreement follows the ICAO recommendations set forth in the following documents:

a) Annex11 to the Convention on International Civil Aviation;
b) Doc 4444;
c) Doc 7030;
d) Doc 9426;
e) Doc 9694;
f) Doc 9880, Part IIa (AIDC);
g) RLA/98/003 Project document;
h) RLA/06/901 Project document; and
i) Final reports of the SAM/IG/1 and SAM/IG/2 meetings.

4. **Safety**

4.1 Each State must ensure that its communication networks involved in the interconnection have the required protection for this type of service, taking into account, at least, the following aspects:

a) protection from invasions by unauthorised persons and/or systems;

b) protection from computer virus attacks; and

c) exclusive use of the equipment for the interconnection services of automated systems.

5. **Operational Aspects**

5.1 The Administrations agree, within their own jurisdictions, to provide direct training on the content of this Memorandum of Understanding to the personnel of the ACCs involved.

5.2 Automated hand-off shall be used as a priority, through transmission of the necessary data between automated systems, in accordance with the specifications set forth in this Agreement.

5.3 However, the transfer may be carried out through other means of communication in such cases where automatic hand-off is not possible.

5.4 The chosen interconnection alternative implies that the States will have to establish specific operational procedures, taking into account available functionalities in each automated system, selecting the set of messages to be used, but observing the specifications and requirements set forth in the documents concerning the chosen solution.

5.5 The States agree to the joint definition of the transition area for the exchange of surveillance data between adjacent ACCs.

5.6 Special attention must be given to the training of controllers on the use of the tools available in the automated systems for the automatic hand-off of air traffic between adjacent FIRs.

6. Technical Aspects

6.1 Interconnection shall meet the following requirements:

a) Enable the automatic transfer of flight plans between adjacent ACCs; and

b) Enable the sharing of surveillance data in areas of common interest.

6.2 The main aspects are:

6.2.1 Analysis of the Current Scenario

6.2.1.1 The analysis of the technical situation of participating States is the first step to complete this mission. In this sense, the SICD, Annex 1 to this Appendix, is the basis to obtain such information, since it contains a detailed description of the interfaces existing in CAR/SAM automated systems, collected and consolidated by type of interface, including radars, their communication protocols, the functionalities of each automated system, and the respective software versions, for example.

6.2.1.2 Each State agrees to verify if the information contained in the SICD needs to be updated and, if so, to inform ICAO of such changes so that they may be included in a new version of the document.

6.2.2 Choosing the Exchange Scenario

6.2.2.1 It is up to the States to choose the exchange scenarios to be adopted, based on the interconnection levels existing in their facilities, according to the following alternatives described in Section 4 (Justification and Nature of Changes) in Annex 2 to this Appendix:

a) Only automatic exchange of surveillance data;

b) Only automatic exchange of flight plan data; and

c) Automatic exchange of surveillance data and flight plan data.

6.2.2.2 The States agree to adopt one of the flight plan transfer options established in Section 5 (Concepts for Automated ATC Systems Interconnection) of Annex 2 to this Appendix:

a) Transfer based on ICAO Doc 4444-PANS/ATM;

b) Transfer based on EUROCONTROL OLDI; and

c) Transfer based on ICAO AIDC.

6.2.2.3 Likewise, the States agree to adopt one of the surveillance data exchange options contained in Section 5 (Concepts for Automated ATC Systems Interconnection) of Annex 2 to this Appendix:

a) Exchange based on the Asterix protocol; and

b) Exchange based on proprietary protocols.

6.2.3 **Implementation Strategy**

6.2.3.1 The implementation strategy must include at least the following aspects:

a) Analysis of the impact that the possible solutions could have on the automated systems, the communication systems, and the logistic support;
b) Joint definition of interfaces, including communication protocols;
c) Configuration of the logical and physical connections in the respective sites;
d) Necessary adjustments to both hardware and software;
e) Definition of the means for data transmission, using the REDDIG for communications between the States; and
f) Testing of all infrastructure including the verification and certification of the interconnection for both flight plans and radar data.

6.2.4 **Implementation**

6.2.4.1 The Interconnection Management Committee must manage the implementation in accordance with the directions issued by common agreement by the States, establishing implementation deadlines, the hiring of third party services, and the distribution of responsibilities, among other relevant topics.

6.2.5 **Operation Supervision**

6.2.5.1 Each State must be responsible for supervising the operation of its systems, including the maintenance of its equipment and systems, ensuring availability, performance, safety, and efficiency required.

6.2.5.2 All of the problems of uncertain origin must be analysed jointly by the States, through the Interconnection Management Committee, which will coordinate the necessary actions to correct them.

6.2.5.3 However, each State must take all the measures within its reach to carry out the actions under its responsibility, reporting its completion to the Interconnection Management Committee.

6.2.5.4 In any event, the Interconnection Management Committee must be constantly informed of any anomalies, regardless of their origin.

6.2.6 **Training**

6.2.6.1 The participating States must develop training programmes for the technical teams responsible for maintaining their systems, taking into account aspects such as duration, frequency, and technical evolution.

6.2.6.2 Teams must be prepared for contingencies and must have the technical capacity to analyse anomalies.

6.2.6.3 Each State shall develop its own Action Plan, containing the technical information required for the interconnection with adjacent ACCs. The plan shall include at least:

a) the topology of the networks involved, with the technical details of the necessary bandwidth, availability, latency, and redundancy;
b) the specification of the equipment used;
c) maintenance requirements;
d) maintenance procedures: preventive, predictive, and corrective; and
e) all of the associated technical documents.

6.3 The States agree that the means of communication for implementing the interconnection will be the REDDIG.

7. **Administrative Aspects**

7.1 This Agreement is a dynamic document that can be revisited at any time, in keeping with the technological evolution of automated systems and of the communication networks of the participating States.

7.2 All interconnection management shall be under the responsibility of the Interconnection Management Committee established by the two (2) States, in accordance with the following:

7.2.1 **Organisational Structure**

7.2.1.1 In order to carry out its activities, the Committee shall have the following organisational structure:

a) **Coordinator**

- The States agree on the appointment of a Coordinator, who may be from any of the States involved, from other States, or from an international organisation; and

- The coordinator will be responsible for the general coordination of all the activities of the technical and operational groups, and for contacting other organisations to discuss interconnection issues.

b) **Technical Group**

- It must include technical experts, designated by the two States, with proven training in the areas of expertise, especially on communication networks and automated computer systems; and

- Will be responsible for carrying out and/or coordinating, in their own countries, the technical activities necessary for the implementation, maintenance, and support of automated systems, communication networks, and interconnection equipment components.

c) **Operational Group**

- It must include air traffic control specialists designated by the two States, with proven training in their areas of expertise, especially on the automated computer systems used in the ACCs.

7.2.2 **Duties**

7.2.2.1 The Committee is responsible for all coordination necessary for planning, implementation, maintenance, and support to the operation of systems and equipment involved in the interconnection of automated systems.

7.2.2.2 It must also ensure the security of the information transmitted between the automated systems involved in the interconnection.

7.2.2.3 As part of its duties, it must control and update all the technical and operational documentation.

7.2.2.4 It is also responsible for the network topology to be used for the interconnection, which shall be approved by the two (2) States.

7.2.2.5 The implementation of the interconnection shall be coordinated and controlled by the Committee through action plans previously approved by the two (2) States.

7.2.2.6 The Committee shall advise the States on the need for technological evolution of the equipment and systems involved in the interconnection, taking into account the technical requirements set forth in Annex 3 – SSS, to this Appendix, among others.

7.2.2.7 Its teams must monitor the performance, stability, reliability, and integrity parameters of the equipment and systems used in the interconnection, as well as propose and supervise corrective actions. To this end, they must use tools for analysing anomalies, such as radar protocol analysers and communication lines.

7.2.2.8 The Committee shall establish the necessary procedures to correct failures.

7.2.2.9 It shall also provide for the resolution of problems encountered, together with the participating States.

7.2.3 **Management Process**

7.2.3.1 In order to carry out its activities, the Interconnection Management Committee will use the following management approach:

a) Holding periodical meetings and discussions to identify the requirements, preferred technical solution(s), alternatives, and options for achieving the interconnection of automated systems;

b) Exchanging the technical reports and documentation, plans, and programmes that could be necessary to ensure the successful and timely completion of these efforts; and

c) The planning, technical coordination, and development of activities between the two (2) States.

8. **Financial Aspects**

8.1 Regarding financial aspects, the States agree to the following:

8.1.1 **Procurement of equipment, components, and systems**

8.1.1.1 The equipment required for implementing the interconnection will be procured by each State, in accordance with the technical specifications approved by the Interconnection Management Committee.

8.1.2 **Procurement of Spare Part Lots**

8.1.2.1 The spare parts of the equipment used for the interconnection will be procured by each State, based on its specific needs, but in keeping with the maintenance guidelines issued by the Interconnection Management Committee.

8.1.3 **Procurement of Third Party Services**

8.1.3.1 Each State agrees to pay for the expenses of any third party service that may be required, such as software adjustments, projects, and communication network implementation.

8.1.3.2 Each State will be responsible for covering its respective share of the expenses related to upgrades to the REDDIG to address increased traffic, in accordance with the guidelines of the REDDIG Administration.

9. **Attachments**

a) Preliminary System Interface Control Document for the Interconnection of ACC Centers of the CARSAM Region – SICD;

b) CAR/SAM Automated ACC interconnection Plan;

c) Preliminary Reference System/Subsystem Specification SSS for the Air Traffic Control Automation System; and

d) Interface Control Document (ICD) for data communication between ATS units in the Caribbean and South American Regions (CAR/SAM ICD).

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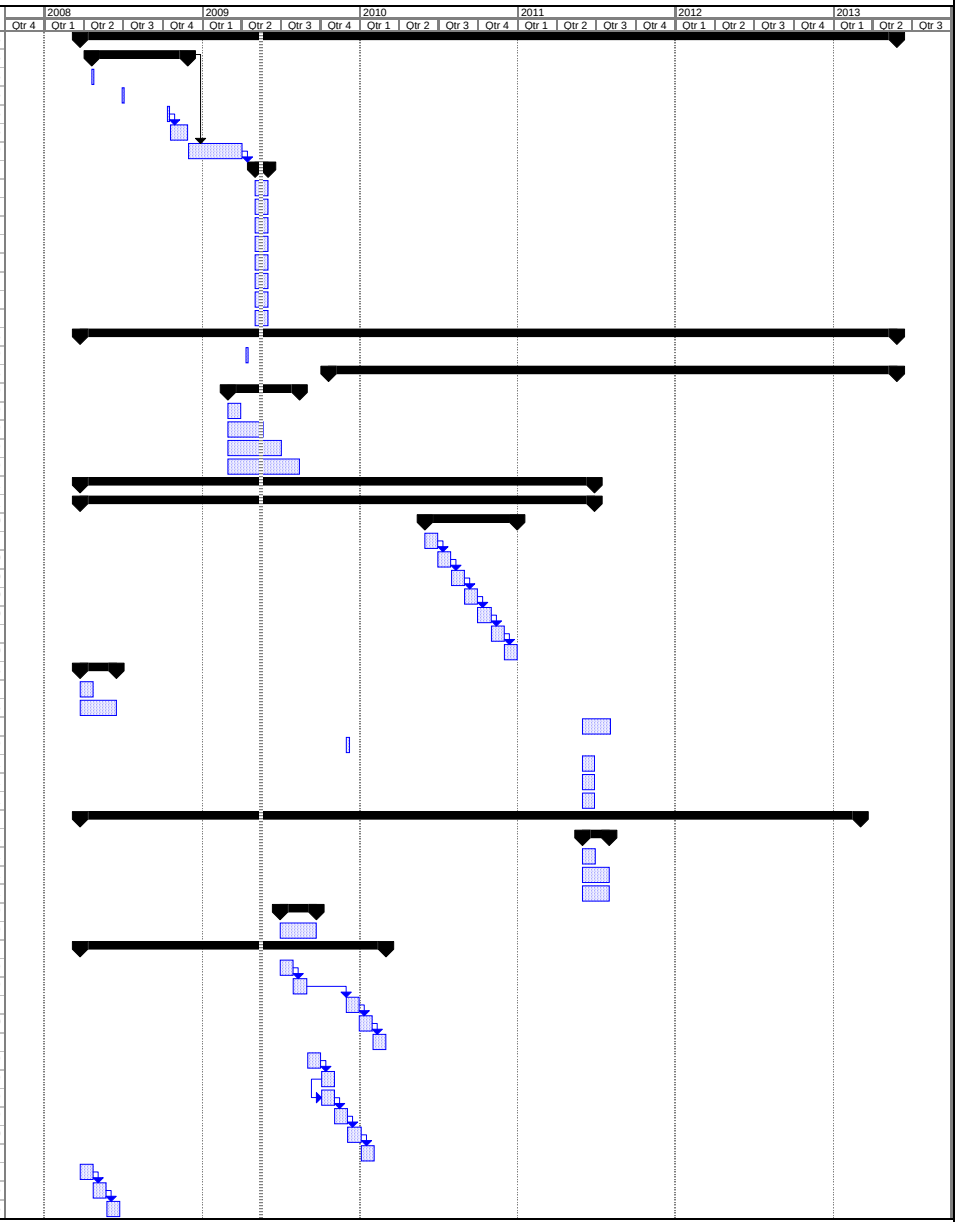
Appendix B to Report on Agenda Item 7-Apéndice B al Informe sobre la Cuestión7 del Orden del Día

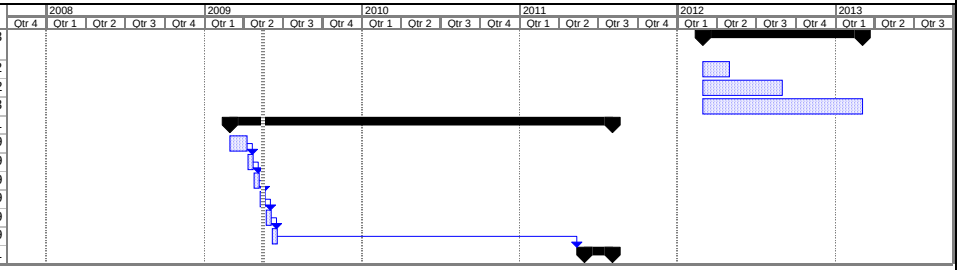
ID	Nome da tarefa	Duration	Start	Finish
1	SAM Interconection Plan	1351 days	Tue 3/25/08	Tue 5/28/13
2	Plan Approval	160 days	Mon 4/21/08	Fri 11/28/08
3	Plan Presentation in the 1ª GT CNS/ATM SAM-ATM/CNS/IG 1 Meeting	5 days	Mon 4/21/08	Fri 4/25/08
4	Plan Presentation ATM/CNS/SG/6	5 days	Mon 6/30/08	Fri 7/4/08
5	Plan presentation in the GREPECAS Meeting	5 days	Mon 10/13/08	Fri 10/17/08
6	CAR/SAM interconnection plan Approval	30 days	Mon 10/20/08	Fri 11/28/08
7	Project Managing Board Creation	90 days	Mon 12/1/08	Fri 4/3/09
8	Project Organization	22 days	Mon 5/4/09	Tue 6/2/09
9	Managing plan	22 days	Mon 5/4/09	Tue 6/2/09
10	Communication Plan	22 days	Mon 5/4/09	Tue 6/2/09
11	Human resources Plan	22 days	Mon 5/4/09	Tue 6/2/09
12	Cost Plan	22 days	Mon 5/4/09	Tue 6/2/09
13	Risk Assesment Plan	22 days	Mon 5/4/09	Tue 6/2/09
14	Escope Managing Plan	22 days	Mon 5/4/09	Tue 6/2/09
15	Quality plan	22 days	Mon 5/4/09	Tue 6/2/09
16	Procurement and Acquisition plan	22 days	Mon 5/4/09	Tue 6/2/09
17	Plan execution	1351 days	Tue 3/25/08	Tue 5/28/13
18	SAM/IG/3 MEETING	5 days	Mon 4/13/09	Fri 4/17/09
19	Coordination Meetings	940 days	Wed 10/21/09	Tue 5/28/13
28	Institutional/Legal Documents Creation	120 days	Mon 3/2/09	Fri 8/14/09
29	Responsability definition over Shared Resources	22 days	Mon 3/2/09	Tue 3/31/09
30	Operational Agreements Between States	60 days	Mon 3/2/09	Fri 5/22/09
31	Surveilance Area definition to be shared	90 days	Mon 3/2/09	Fri 7/3/09
32	Security Plan	120 days	Mon 3/2/09	Fri 8/14/09
33	Flight Plan Interconection Implementation	851 days	Tue 3/25/08	Tue 6/28/11
34	Flight Plan interconnection using OLDI	851 days	Tue 3/25/08	Tue 6/28/11
35	First Phase	154 days	Tue 6/1/10	Fri 12/31/10
36	EZEIZA-SANTIAGO	22 days	Tue 6/1/10	Wed 6/30/10
37	BOGOTÁ-GUAYAQUIL	22 days	Thu 7/1/10	Fri 7/30/10
38	BOGOTÁ-PANAMÁ	22 days	Mon 8/2/10	Tue 8/31/10
39	BOGOTÁ-BARRANQUILLA	22 days	Wed 9/1/10	Thu 9/30/10
40	BARRANQUILLA-PANAMÁ	22 days	Fri 10/1/10	Mon 11/1/10
41	SANTIAGO-CORDOBA	22 days	Tue 11/2/10	Wed 12/1/10
42	PANAMÁ-CENAMER	22 days	Thu 12/2/10	Fri 12/31/10
43	Second Phase (With Brazil)	60 days	Tue 3/25/08	Mon 6/16/08
46	AMAZÓNICO-BOGOTÁ	22 days	Tue 3/25/08	Wed 4/23/08
45	Flight Plan interconnection using Doc 4444 (CDN, LAM, ACP)	60 days	Tue 3/25/08	Mon 6/16/08
86	Flight Plan interconnection using AIDC	47 days	Wed 6/1/11	Thu 8/4/11
47	EZEIZA-CORDOBA	6 days	Tue 12/1/09	Tue 12/8/09
48	EZEIZA-MONTEVIDEO	20 days	Wed 6/1/11	Tue 6/28/11
49	CURITIBA-EZEIZA	20 days	Wed 6/1/11	Tue 6/28/11
50	CURITIBA-MONTEVIDEO	20 days	Wed 6/1/11	Tue 6/28/11
51	Surveillance Data interconnection Implementation	1291 days	Tue 3/25/08	Tue 3/5/13
52	Surveillance Data interconnection Implementation using Intercenter ASTERIX 62/63	44 days	Wed 6/1/11	Mon 8/1/11
53	EZEIZA-MONTEVIDEO	22 days	Wed 6/1/11	Thu 6/30/11
54	CURITIBA- MONTEVIDEO	44 days	Wed 6/1/11	Mon 8/1/11
55	CURITIBA - EZEIZA	44 days	Wed 6/1/11	Mon 8/1/11
56	Surveillance Data interconnection Implementation with Proprietary ICD	60 days	Wed 7/1/09	Tue 9/22/09
57	AMAZONICO-MAIQUETIA	60 days	Wed 7/1/09	Tue 9/22/09
58	Surveillance Data interconnection Implementation using ASTERIX Radar ICD	506 days	Tue 3/25/08	Tue 3/2/10
59	EZEIZA-SANTIAGO	22 days	Wed 7/1/09	Thu 7/30/09
60	EZEIZA-CORDOBA	22 days	Fri 7/31/09	Mon 8/31/09
61	EZEIZA- MONTEVIDEO	22 days	Tue 12/1/09	Wed 12/30/09
62	AMAZÓNICO-BOGOTÁ	22 days	Thu 12/31/09	Fri 1/29/10
63	CURITIBA-MONTEVIDEO	22 days	Mon 2/1/10	Tue 3/2/10
64	SANTIAGO-CORDOBA	22 days	Thu 9/3/09	Fri 10/2/09
65	BOGOTÁ-GUAYAQUIL	22 days	Mon 10/5/09	Tue 11/3/09
66	BOGOTÁ-PANAMÁ	22 days	Mon 10/5/09	Tue 11/3/09
67	BOGOTÁ-BARRANQUILHA	22 days	Wed 11/4/09	Thu 12/3/09
68	BOGOTÁ-MAIQUETIA	22 days	Fri 12/4/09	Mon 1/4/10
69	BOGOTÁ-LIMA	22 days	Tue 1/5/10	Wed 2/3/10
71	BARRANQUILLA-PANAMÁ	22 days	Tue 3/25/08	Wed 4/23/08
72	BARRANQUILLA-MAIQUETIA	22 days	Thu 4/24/08	Fri 5/23/08
73	MAIQUETIA-PIARCO	22 days	Mon 5/26/08	Tue 6/24/08



Projeto: SAMIG2_Asu6 ApA Bil
Data: Fri 5/15/09

Tarefa | Andamento | Resumo | Tarefas externas | Divisão
Divisão | Etapa | Resumo do projeto | Etapa Tarefa

ID	Nome da tarefa	Duration	Start	Finish
74	Surveillance Data interconnection Implementation using RADNET for the CAR/SAM Region	264 days	Thu 3/1/12	Tue 3/5/13
75	Specification	44 days	Thu 3/1/12	Tue 5/1/12
76	Acquisition	132 days	Thu 3/1/12	Fri 8/31/12
77	Installation	264 days	Thu 3/1/12	Tue 3/5/13
78	Surveillance Data interconnection Implementation using SISTRASAG	634 days	Mon 3/2/09	Thu 8/4/11
79	BRASIL	30 days	Mon 3/2/09	Fri 4/10/09
80	LIMA	10 days	Mon 4/13/09	Fri 4/24/09
81	LA PAZ	10 days	Mon 4/27/09	Fri 5/8/09
82	ASSUNCION	10 days	Mon 5/11/09	Fri 5/22/09
83	GEORGETOWN	10 days	Mon 5/25/09	Fri 6/5/09
84	PARAMARIBO	10 days	Mon 6/8/09	Fri 6/19/09
85	ROCHAMBEAU	47 days	Wed 6/1/11	Thu 8/4/11



Projeto: SAMIG2_Asu6 ApA Bil
Data: Fri 5/15/09

Tarefa | Andamento | Resumo | Tarefas externas | Divisão
Divisão | Etapa | Resumo do projeto | Etapa Tarefa

Agenda Item 8: Other business

RNP AR Approach Procedure Cuzco Airport

8.1 The Meeting was informed about the RNP AR APCH procedure designed by Peruvian aeronautic authority with the support of NAVERUS for Cuzco airport. The effort made by DGAC and LAN Peru in the implementation process can definitely be noted, hoping that same be definitely approved by the second semester of 2009.

Designators Five Letter Name Code (5LNC)

8.2 The Secretariat made a presentation about 5LNC (ICARD 5LNC) data base and of the procedure that will be carried out in the future for the assignment of the key names for report points. This data base is being completed with the information provided by the different ICAO Regions and has the purpose to count with a designators data base at a worldwide level, and also when the States require codes, enter through the use of a user name and a password assigned to each State. The data base is lodged in the Eurocontrol web portal in the following address: **http://www.eurocontrol.int/icard/public/subsite_homepage/homepage.html**.

8.3 Once selected the 5LNC required, an authorization process is initiated by corresponding Regional Office. In order to put in practice this system, ICAO SAM Regional Office will send to the States a communication requesting to designate a focal point and a second alternative, in order to manage this data base.

Worldwide Forum on Civil/Military Coordination

8.4 The Meeting also took note on the Worldwide Forum on Civil/Military Coordination Management organized by ICAO that will be carried out in ICAO headquarters in Montreal, Canada, from 19 to 23 October 2009. This forum has as its main objective to improve the civil/military coordination and cooperation, with the purpose to support the optimum use of airspace by all users in order to effectively satisfy the requirements of civil aviation, national defence and of the environment.

8.5 The civil and military authorities of SAM States were invited to attend this forum that will certainly make easier the implementation of the routes network optimization of the Region, being informed at first hand about all the subjects related to this important matter. A brochure with information of this event has been included in **Appendix A** to this part of the Report.

APPENDIX A

A MUST-ATTEND EVENT

GLOBAL AIR TRAFFIC MANAGEMENT FORUM ON CIVIL/MILITARY COOPERATION

ICAO Headquarters, Montréal, Canada
19 to 21 October 2009

Time to take it Global:

Meeting each other's needs without compromising the Mission

The International Civil Aviation Organization (ICAO) invites you to attend, sponsor and/or exhibit at the Global Forum on Civil/Military Cooperation. Be part of a unique event that will bring together civilian and military airspace users. Participate in the presentations and discussions on the need to improve civil/military cooperation and coordination in support of optimum use of airspace by all users to effectively meet operational requirements of air transportation, national defence and environmental conservation.

Forum Focus:

- Understanding common requirements and diverse operating needs
- The need to move toward a more interoperable and seamless Global Air Navigation System
- Security and Sovereignty Considerations
- Unmanned Aircraft Systems (UAS): Needs and challenges
- Regional and National Airspace Planning

In partnership with:

- Civil Air Navigation Services Organisation (CANSO)
- European Organisation for the Safety of Air Navigation (EUROCONTROL)
- International Air Transport Association (IATA)
- North Atlantic Treaty Organization (NATO)

and supported by Air Traffic Control Association (ATCA) and UVS International (UVSI)

Simultaneous interpretation into ICAO's working languages: Arabic, Chinese, English, French, Russian and Spanish.

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