Agenda Item 3: **SAM airspace optimization**
a) En-route PBN
b) PBN en terminal areas
c) PBN procedures

Phraseology and professional culture in air traffic controllers and flight crews during the implantation of PROESA airspace.

(Presented by Peru)

SUMMARY:

This working paper presents some results of the feedback obtained from air traffic controllers during PROESA first-stage post-implantation assessments.

REFERENCES:

Procedures for Air Navigation Services – Air Traffic Management (PANS-ATM, Doc. 4444)

ICAO strategic objectives:	*A- Safety* *B – Air navigation capacity and efficiency.*

1. Background:

1.1 In 2011, new standard departure and arrival procedures were introduced into the Terminal Area of Lima, several of them were designed with RNAV specification.

1.2 In the year 2013, the Civil Aviation Authority of Peru, convinced of the advantages which represent the development and implementation of an airspace concept under the framework of PBN, decided to promote the Airspace Reorganization Program and Implementation of Performance Based Navigation in the whole FIR Lima airspace, named PROESA.

1.3 PROESA is divided into several stages, and each stage is based on the activities described in Doc.9992. The first stage was implemented on 24 July 2014, and included new standard arrival and departure procedures designed for TMA Lima with navigation specification RNAV1 RNP1.

1.4 Currently, a PROESA first-stage post-implantation assessment is being conducted, which includes the feedback received from both, flight crews flying new procedures, and air traffic controllers managing a whole new airspace. This feedback has been reflected in the introduction of several adjustments to the new procedures.

2. Conceptual changes in the management of an all-new airspace:

2.1 Implantation of RNAV 1 and RNP 1 specification in most of the SID and STAR procedures designed for TMA Lima, as well as the incorporation of Continuous Climb Operations elements (CCO) e.g. “level windows”, meant for air traffic controllers an important conceptual change in managing an all-new airspace, even though they were familiar with this type of procedures since 2011.

2.2 During training and dissemination activities of the new SID and STAR procedures, and the new airspace configuration of TMA Lima, a need for developing and strengthening many theoretical and ATC operational aspects was observed:

a) Confidence of air traffic controllers in the “preparatory” work of airspace planners and procedure designers.
b) Get familiar with "Level Windows", established at several crossing points between SID and STAR paths, which should reduce tactical intervention of controllers in providing separation to arrival and departure flows, and contributing with continuous climb operations (CCO).
c) Reinforcement of “Open STAR” and “Closed STAR” concepts, as well as its relationship with vectoring.
d) Vectoring of an aircraft already executing an RNAV/RNP procedure.
e) Operation and efficiency of Flight Management Systems (FMS) and their capability to perform database based procedures.
f) Use of adequate standard phraseology related to compliance of published vertical profiles in SIDs and STARs

3. Post-implantation feedback:

3.1 Validation and evaluation activities of the new SID and STAR procedures were carried out in a Real Time Simulator (RTS), ***AirCon INDRA 2100***, although the capability to reproduce a very realistic operational scenario, the intervention of air traffic controllers carrying out "pseudo-pilot" tasks, caused that in many cases navigation and aircraft performances differed from "real operations" of various operators of TMA Lima, and, that air traffic controllers faced a completely different real scenario from the simulated one.

3.2 As part of PROESA first-stage post-implantation assessment, it has been receiving a constant feedback from ATC staff related to their experiences in providing tactical control, and the interaction of the main departure and arrival flows in real time.

3.3 From this feedback, the two most-common events in the new TMA Lima airspace reported by air traffic controllers were:

a) Non-compliance with the level windows set in the SID vertical profile.
b) Misinterpretation of VM path terminator (*) in an Open STAR.

4. Non-compliance with the level windows set in the vertical profile of ATOGO1F and ISREN1F departures:

4.1 RNAV 1 / RNP 1 standard departure routes *ISREN1F* and *ATOGO1F* lead departing aircraft from runway 15 to destinations in northern Peru. Several level windows have been set to maintain vertical separation from the main southern arrival traffic flow. (**See Figure 1).**

(*) VM path terminator: heading to manual termination.

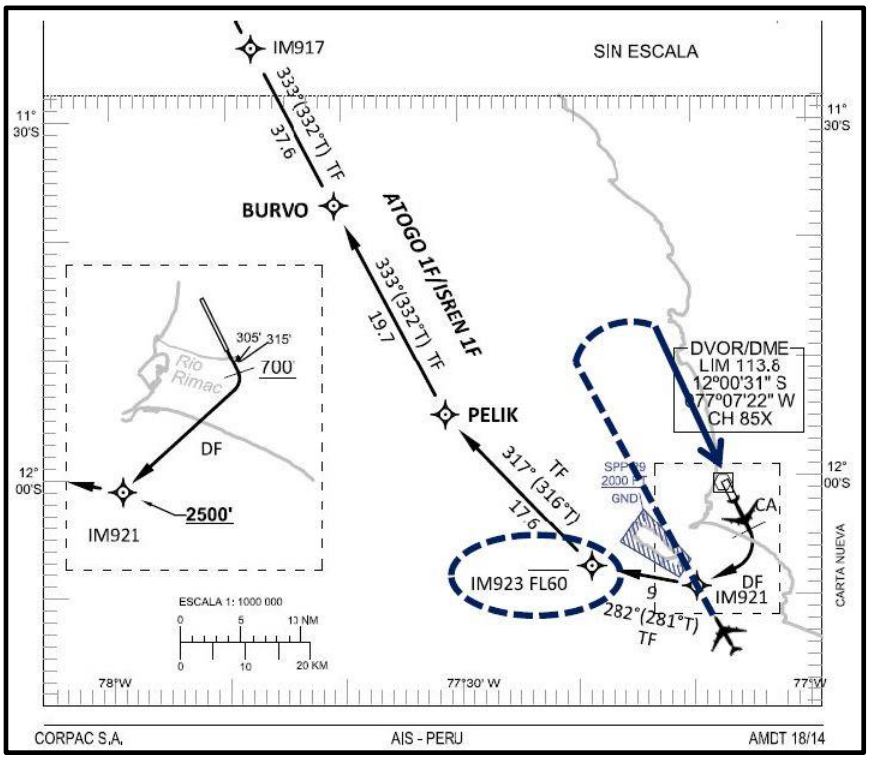


Figure 1: ISREN1F and ATOGO1F "level windows".

4.2 The main "level window" is located at the waypoint ***IM923***, which must be flown at flight level six-zero or less.

4.3 Air traffic controllers expressed their concern when they detected that a large number of flight crews, who, after being established the first contact with the departure control, and being instructed to climb to cruise level, these flights started an unauthorized-unrestricted climb, cancelling automatically the whole level restrictions published in the vertical profile of the SID. This situation could be observed directly on the radar screens in real time, as well as in pictures sent by ATC staff.

4.4 Operation of high performance aircraft executing unauthorized-unrestricted climbs, and reaching higher levels in the vicinity of the airport, originated the appearance of unwanted states that required immediate tactical intervention to avoid transgressing regulatory minimum separation.

4.5 Similarly, they expressed that despite using standard phraseology contained in the Doc.4444 Chapter 12 to issue climb instructions, many flight crews continued executing an unrestricted climb, causing the need to use additional communications to emphasize that they should comply with the published vertical profile, specifically related to the constraint of maintaining flight level six-zero until crossing waypoint ***IM923***.

4.6 Although these situations caused an increase in workload, by having to reinforce surveillance at some crossing points for which these level windows had been established, the most striking consequence was the mistrust generated among air traffic controllers regarding the efficacy of PBN procedures in the management of airspace and how flight crews flew these procedures.

4.7 Regarding climb clearances, Doc.4444 Chapter 6.3.2.4 specifies the following:

"CLIMB CLEARANCE ABOVE LEVELS SPECIFIED IN A SID

When a departing aircraft on a SID is cleared to climb to a level higher than the initially cleared level or the level(s) specified in a SID, the aircraft shall follow the published vertical profile of a SID, unless such restrictions are explicitly cancelled by ATC."

4.8 In addition, to cancel one or all level restrictions, when it is convenient for the ATC, Doc.4444 Chapter 12.3.1.2 specifies the following phraseology:

"LEVEL CHANGES, REPORTS AND RATES:

***a) CLIMB** followed as necessary by **TO** (level)*

...clearance to cancel level restriction(s) of the vertical profile of a SID during climb:

***z) CLIMB TO** (level) [**LEVEL RESTRICTION**(S) (SID designator) **CANCELLED** (or) LEVEL RESTRICTION(S) (SID designator) AT (point) CANCELLED];"*

4.9 It was determined that many of the crews that carried out international flights, mainly to the United States, used FAA phraseology as reference, which contains differences in the meaning of climb clearances.

4.10 The FAA document InFO 12014 Subject: "Climb Via" Standard Instrument Departure for Phraseology (SID) Modification to "Descend Via" Phraseology for Standard Terminal Arrival (STAR), and Phraseology Speed Associated With Instructions "specifies the following phraseology:

***a)** **"CLIMB VIA**: An abbreviated ATC clearance that requires compliance with the procedural lateral path, associated speed restrictions and altitude restrictions along the cleared route or procedure. Subsequent issuance of a **"maintain"** clearance deletes published altitude restrictions"*

***b)** **"CLIMB/DESCEND AND MAINTAIN** (altitude): Pilot is expected to vacate current altitude and commence an unrestricted climb/descent to comply with the clearance. For aircraft already climbing via a SID, or descending via a STAR, published altitude restrictions are deleted unless reissued by ATC"*

***c)** **"COMPLY WITH RESTRICTIONS**: requires aircraft joining or resuming a procedure to comply with published restrictions. May be used in lieu of reissuing individual restrictions"*

4.11 Given the problems described above, the Aviation Authority of Peru considered it appropriate to issue a NOTAM to remind flight crews to comply with published vertical profiles in SIDs, and whose content is as follows:

"PILOTS CLIMBING IN A STANDARD INSTRUMENT DEPARTURE (SID) MUST FOLLOW PUBLISHED VERTICAL PROFILE AND LEVEL RESTRICTIONS, UNLESS SUCH RESTRICTIONS ARE EXPLICITY CANCELLED BY ATC"

4.12 In addition, CORPAC S.A. (ANSP) has incorporated the word "VIA" to phraseology used in climbing clearances, considering that this word is aligned with FAA phraseology, does not lead to confusion to flight crews already familiar with ICAO phraseology and whose meaning requires compliance with the published lateral path, speed and altitude restrictions.

4.13 When it is necessary or convenient to cancel any published altitude restriction of a SID, ATC shall use ICAO phraseology contained in Doc. 4444 Chapter 12.3.1.2.

4.1 Examples of phraseology in English:

a) Phraseology regarding clearance to maintain the published vertical profile of a SID during climb:

ICAO: ***"(Callsign) CLIMB TO FLIGHT LEVEL 340"***

FAA: ***"(Callsign) CLIMB VIA ISREN1F DEPARTURE TO FLIGHT LEVEL 340"***

PERU: ***"(Callsign) CLIMB TO FLIGHT LEVEL 340 VIA ISREN 1F"***

b) Phraseology regarding clearance to cancel level restriction(s) of the vertical profile of a SID during climb.

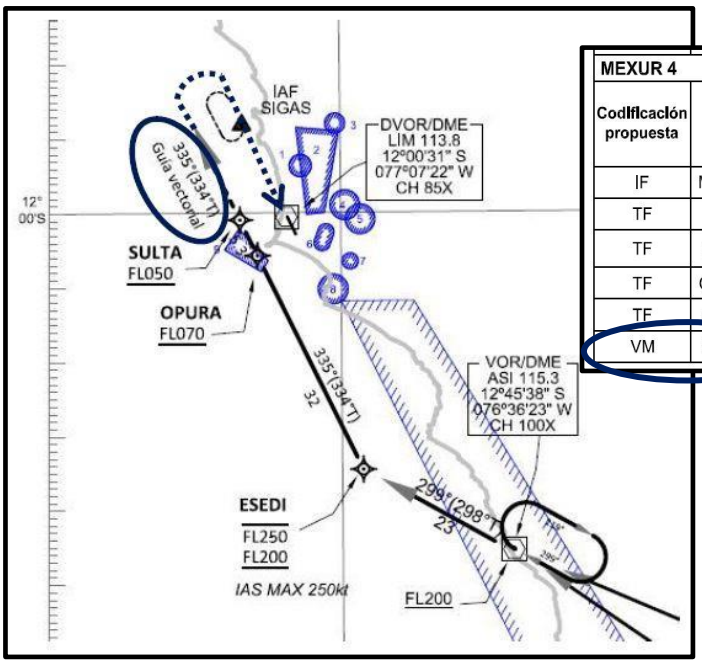
ICAO: ***"(Callsign) CLIMB TO FLIGHT LEVEL 340, LEVEL RESTRICTIONS ISREN1F CANCELLED"***

FAA: ***"(Callsign) CLIMB AND MAINTAIN FLIGHT LEVEL 340"***

5. **Misinterpretation of VM path terminator in an Open STAR:**

5.1 Several of the RNAV/RNP Standard Arrival Routes from the south to the runway 15 were designed with the criteria of "OPEN STARs".

5.2 These STARs must be flown up to a point, called SULTA, whose path terminator is VM (heading to a manual termination). This means that after SULTA, flight crews should receive vectoring to intercept a pilot-interpreted navigation aid to execute an instrument approach procedure, and shall disconnect the database automatic navigation in the flight management system. (**See Figure 2**)



MEXUR 4									
Codificación propuesta	WP	Latitud	Longitud	Fly Over	Marcación Derrota M° (T°)	Distancia NM	Dirección del viraje	Altitud	Límite velocidad
IF	MEXUR	13°10'04.00"S	075°40'13.00"W	-	295°(294°)	60	-	+FL250	-
TF	ASI	12°45'38.3"S	076°36'23.3"W	-	299°(298°)	23	-	+FL200	-
TF	ESEDI	12°34'38.1"S	076°57'06.4"W	-	335°(334°)	32	R	-FL250 +FL200	250
TF	OPURA	12°05'46.5"S	077°11'26.6"W	-	335°(334°)	5.3	-	+FL070	-
TF	SULTA	12°00'58.3"S	077°13'49.4"W	-	335°(334°)	-	-	+FL050	-
VM	SULTA	12°00'58.3"S	077°13'49.4"W	-	335°(334°)	-	-	-	-

Figure 2: Open STAR and VM path terminator.

5.3 STAR procedures, at the time of being coded and inserted into the flight management systems (FMS) must necessarily maintain a "union" between all waypoints to be flown by the aircraft, and then, these procedures must be necessarily linked with the Initial Approach Fix (IAF) of the instrument approach procedure which will be executed by the aircraft.

5.4 In an open STAR, the union between the end point of the STAR and the IAF is not contemplated, due to the reserved space for vectoring, and, not being possible to have a "discontinuity" between waypoints in the FMS, the waypoint ***SULTA*** is joined directly with IAF ***SIGAS***.

5.5 Air traffic controllers explained that several flight crews, mainly foreign, despite having been instructed to keep flying their current heading after SULTA, and having been informed about expecting vectors after SULTA to intercept an instrument approach procedure, contrary, they flew direct from SULTA to SIGAS, facing all the aircraft already established in the approach path to the runway 15. These situations demanded inmediate tactical intervention to avoid transgressing regulatory minimum separations, and/or the initiation of a resolution advisory (RA) that will lead them to execute a missed approach procedure. (**See Figure 3**).

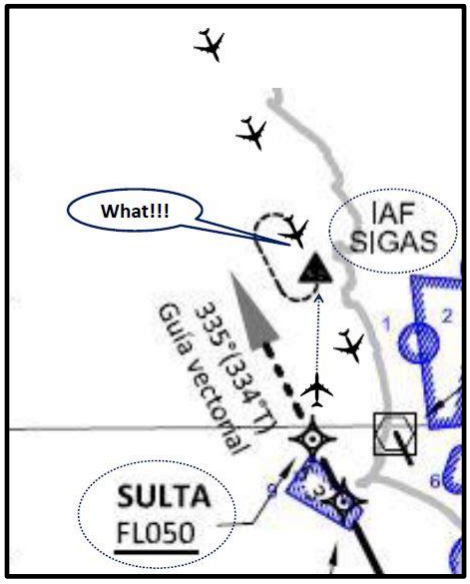


Figure 3: An aircraft flying from SULTA to SIGAS

5.6 Once again, is worth mentioning that, although these situations caused an increase in workload, the most striking consequence was the distrust generated among air traffic controllers regarding how flight crews interpret the information contained in their FMS, as well as the training and experience in the management of the aircraft navigation during the execution of open STAR procedures.

5.7 Facing this problem, air traffic controllers have reinforced the monitoring of all flight tracks after passing ***SULTA***, and they have reminded flight crews the need to maintain the assigned heading waiting, avoiding a direct flight to the IAF. Also, a description of after-***SULTA*** communication failure procedure has been provided in clear text.

6. **Suggested action:**

6.1 The Meeting is invited to:

a) Take note of the information contained in this working paper regarding lessons learned by Peru during the implantation of PROESA PBN airspace.
b) Strengthen training activities of air traffic controllers and flight crews to ensure the safe conduct of air operations.
c) Consider the need to harmonize the phraseology used by the FAA and ICAO.

d) Review the information posted on the following links:

- http://www.faa.gov/air_traffic/publications/atpubs/pcg/
- http://www.faa.gov/regulations_policies/orders_notices/index.cfm/go/document.information/documentID/1023549
- http://www.faa.gov/documentLibrary/media/Order/ATC.pdf
- http://www.capmembers.com/media/cms/FAA_Phraseology_Climb_Via__Descend__6A2824BA854D4.pdf
- http://www.corpac.gob.pe/Main.asp?T=5130

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