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Use of VFR aerodromes with RNP Approach as backup for big airports

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Abstract
This article is about analysis of possible use of VFR aerodromes with RNP approach as backup for big airports in times, when they are inoperable. Main goal of this article is to analyse if such an idea is worth considering and if so decide which aerodromes are the most suitable for implementation of LPV procedure. It also contains detailed look at equipment of VFR aerodromes and comparison to equipment required for LPV Approach and needed by IFR traffic.

Key words LPV, backup, VFR, aerodromes

1. INTRODUCTION

LPV procedure is well-known in North America and from 2011 it also slowly started being implemented in the Europe. Because of this, it is important to analyse if such a process would bring any benefits to aviation in Czech Republic. Main objectives are the description of existing equipment on VFR aerodromes, comparison of this equipment with equipment needed by approach with vertical guidance and with equipment possibly needed by IFR traffic on this aerodrome. At the end will be few suggestions of specific aerodromes that could possibly be backups for big airports in Czech Republic.

2. RNP APCH

RNP Approach is type of PBN (Performance Based Navigation) that allows aircraft to fly the chosen route between two defined points in the 3D airspace. RNP sets how precise navigation equipment must be to fit criteria of specific airspaces or during specific procedures. The number after the RNP defines size of the space where aircraft equipment must calculate position of aircraft. This number is equal to size of the radius of circle around real position of aircraft and is reported in nautical miles (NM). The

RNP and RNAV are quite similar except RNP is able to measure its own navigation performance and alert any irregularities.

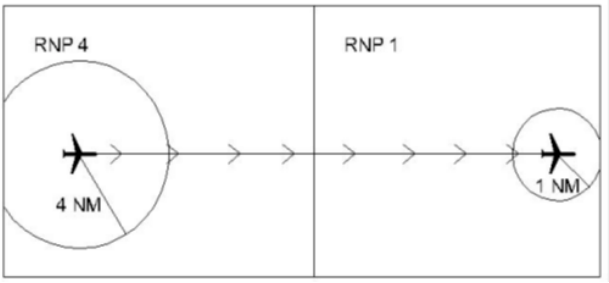

Figure 1: Drawing of different RNP types (*Source: Authors*)

RNP system uses its own navigation sensors, system architecture and operation modes to fulfil navigation criteria set by officially stated RNP minima. It must provide sufficient integrity and data and sensors monitoring, and it can provide additional means to exclude some specific sources of navigation aids so use of fail sensors will be avoided. There are two base kinds of approach:

- Precision Approach (PA): Kind of approach that use systems like ILS, MLS and similar for the final segment of approach. This systems provide both lateral and vertical navigation in selected area with defined route of continuous descend.
- Non-precision approach (NPA): This contains approaches that use VOR, NDB or basic GNSS and similar navigation aids that provides only lateral navigation at the stage of final approach.

Nowadays, there is third category of approaches and it´s approach with vertical guidance other than precision approach.

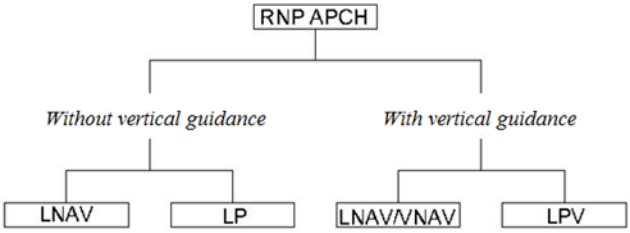

Figure 2: Types of RNP APCH

ICAO Doc. 9613 divides RNP APCH in two main categories which are approaches with and without vertical guidance.

3. AIRPORTS IN THE CZECH REPUBLIC

In the Czech Republic are 84 VFR aerodromes with 113 runways and 8 IFR airports with 15 runways.

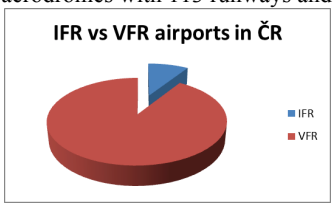

Figure 3: Number of IFR airports compared to VFR (*Source: Authors*)

Such a huge difference between VFR and IFR airports is first thing that could lead to effort of greater use of the VFR aerodromes. If this use would be a backup for big airports then it is appropriate to focus on aerodromes with paved runways. This requirement brings us to 14 aerodromes. They are listed in the next table where they are stated with their runways lengths.

Table 1: Aerodromes with solid runways

Aerodrome	Runway (m)	Material
Panenský Týnec	2505	asphalt-concrete
České Budejovice	2500	concrete
Přerov	2500	concrete
Hradec Králové	2400	concrete
Zábřeh	1950	asphalt
Mnichovo Hradiště	1550	concrete
Příbram	1450	asphalt
Plzeň/Líně	1450	concrete
Hořovice	1170	asphalt
Jindřichův Hradec	700	asphalt-concrete
Otrokovice	650	asphalt-concrete
Vysoké Mýto	600	asphalt
Kříženec	595	asphalt
Olomouc	420	asphalt

Source: Authors

From this group of aerodromes should be removed those in Zábřeh and Olomouc due to damaged runway at the first one and too short runway at second mentioned.

Position of all of these aerodromes is shown on the following figure.

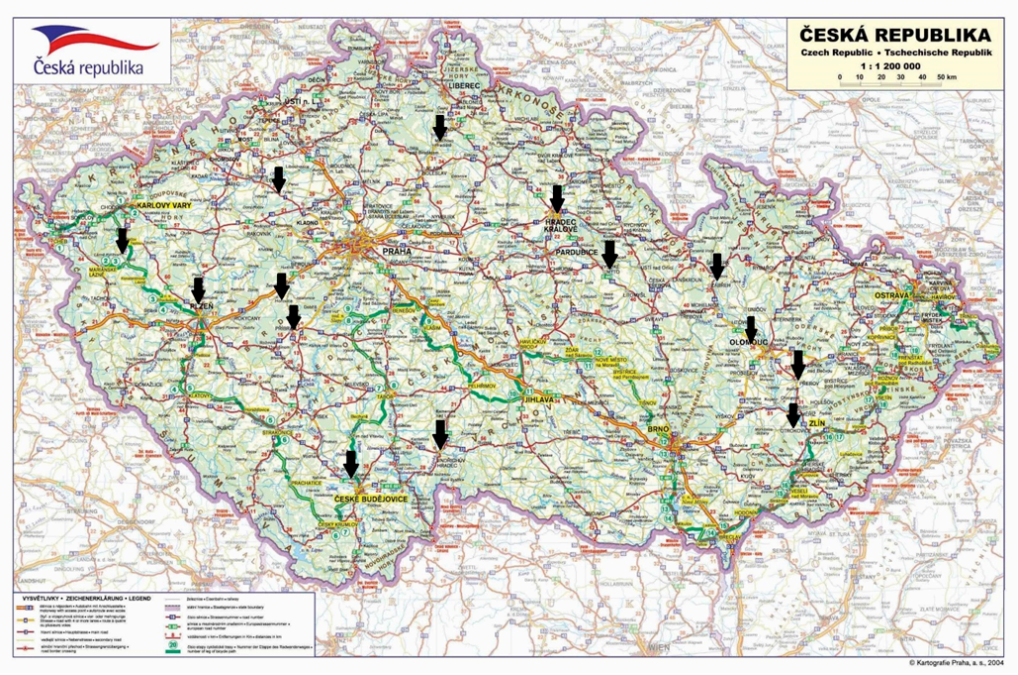

Figure 4: Position of VFR aerodromes with paved runways (*Source: Authors and (4)*)

Second step after selecting appropriate aerodromes is to review their equipment. There are main categories that we should focus on:

- basic aerodrome information
- physics characteristics of the runway
- passport and customs availability
- police, firefighting and medical services
- runway lights
- light approach system
- visual navigation aids
- refuelling opportunities
- infrastructure
- taxiways and paved areas on aerodrome

Here are the conclusions from this analysis:

- only one aerodrome has runway lights
- only one aerodrome has approach lighting system
- three aerodromes have visual navigation aids (PAPI, APAPI)
- 13 aerodromes offer fuel to refuel the aircraft (mostly AVGAS 100LL, few offer JET-A1 and BA-95)
- most of aerodromes has kind of infrastructure that could be possibly used for the security checks or passenger and baggage handling
- most of aerodromes have network of paved taxiways sufficient for safe movement of few aircrafts at the time

4. EQUIPMENT

Equipment needed for approach with vertical guidance is quite basic. First of all it is proper marking of runway. Very important is marking of runway axis. All marking should be made of consistent white colour. These markings could contain some reflexive elements to help increase their visibility.
Technical equipment of such an aerodrome is quite simple as well. Since LPV approach doesn't need any ground equipment for itself, there is just one requirement and it is the runway lights. These lights helps increase runway visibility range. With these lights, aerodrome is able to increase its applicability even in bad weather conditions.
If there is expected IFR traffic on similar aerodrome, it should be equipped with some additional equipment and services. The first one is marker of landing direction. As only few pilots will knew that aerodrome it is important to prevent mistakes during landing. This sign in the shape of letter T will mark direction of landing and therefore helps to take right decisions.
Similar visual aid could be approach lighting system. LPV approach is quite similar to ILS Cat I but building exactly same approach system would be very expensive and maybe even unnecessary. There should be set new category of approach lightning system just for LPV approach that would be little less complicated then system for ILS Cat I.
Next thing that shouldn't be missing at this aerodrome is wind direction indicator. This device is very important, mostly at the final stage of landing.
There should be also services for towing aircrafts in case they need it or they are stuck at the runway. As we expect this aerodrome will only be used for increased IFR traffic when the big airport is un-functional there is no need to buy this devices. This aerodrome could use equipment from the big airport and return after the big one is again fully functional.
Very important is also preventing wildlife to enter the aerodrome area. Since these animals are, mostly in winter months, migrating to the urban areas, where they can found food, fence should be build. Animals are big threat for the aircrafts both at take-off and landing, and they are capable to make a disaster once hit by aircraft.
On this aerodrome we also need to ensure sufficient level of safety on the movement areas. This could be managed by local air traffic service that could make sure that aircraft will safely enter and exit runway and move through aerodrome. Such a service could be managed by procedural air traffic control, which uses reports of pilots to control movement of all present aircrafts. Other solution to this problem is to establish AFIS at this aerodrome.
Other very important element is refuelling service. Once increased traffic will took place on this aerodrome, it is expected that existing tanks on the aerodrome will not be sufficient for this increase. With bigger demand for fuel can be dealt by renting cistern vehicles to provide sufficient amount of fuel and fuel types.

5. EXAMPLE OF BACKUP AERODROMES FOR PRAGUE AIRPORT

Vaclav Havel's airport is the biggest airport in the Czech Republic. It is very important to set crisis procedures in the case of its un-functionality because of amount of traffic flying here and its importance. On the next figure are marked all possible VFR aerodromes that could became a backup for this airport.

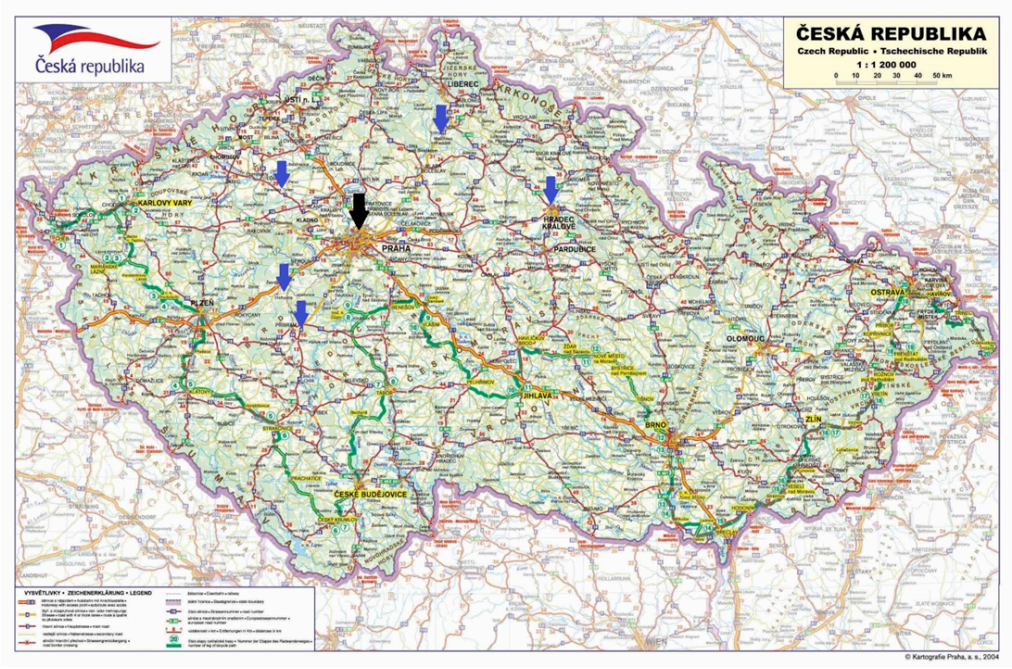

Figure 5: Position of VFR aerodromes usable as backups (*Source: Authors and (4)*)

Distance of these aerodromes from Prague and time needed to get there are included in the next table.

Table 2: Distances and time to Prague

Aerodrome name	Distance (km)	Time
Hradec Králové	**137**	**1 h 24 min**
Mnichovo Hradiště	**88**	**1h 6 min**
Panenský Týnec	**37**	**26 min**
Příbram	**73**	**48 min**
Hořovice	**49**	**32 min**

Source: Authors

From the earlier mentioned analysis of aerodromes equipment and above table of distances and times we are able to decide which aerodromes are more suitable to become backups for Vaclav Havel´s airport in Prague. These aerodromes are Hradec Králové and Panenský Týnec.
Hradec Králové is very well equipped for VFR aerodrome and that's why it is capable of being backup for this big airport. Despite its distance from Prague travelling there is not very complicated due to highway connecting these two cities. Also aerodrome at Hradec Králové is only one aerodrome with runway lights and basic approach lighting system and dispose with PAPI system. On this aerodrome is also possible to refuel JET-A1 fuel beside classic AVGAS 100LL.

Aerodrome at Panenský Týnec is quite closer to the Prague and it has quite long and wide runway. PCN number of this runway is also sufficient for most common airplanes used in IFR traffic. Infrastructure and equipment on this aerodrome is not as good as it is at Hradec Králové but on the other hand position of this aerodrome is much more suitable. Other benefit of investing to the aerodrome at Panenský Týnec is fact that this aerodrome could possibly be a backup for another big airport in Czech Republic – Karlovy Vary.

6. CONCLUSION

From all this information it is easy to see that implementation of LPV approach on proper aerodromes would be very beneficial at very low price. Additional equipment price is not really too high for the benefits it would provide. Very important is also fact that all this changes and modifications could be done within very short time frame. This leads to the argument that such a process could be used in some crisis scenarios. It also brings some economic advantages, although state needs to invest some money to those aerodromes, all the traffic that would otherwise divert to other countries will stay in Czech Republic and therefore use its services like travel, accommodation, etc.

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