Increasing the Usability of Near-Sea Aerodromes
Povećanje iskoristivosti aerodroma blizu mora

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Summary

This article proposes a Cloud-Break Procedure design for the near-sea, coastal and islands VFR1 aerodromes to improve their accessibility for combined VFR/IFR2 flights. Current drawbacks of performing combined flights from VFR aerodromes are highlighted firstly. The analysis that follows deals with possible options that would lead to improvement of current situation and suggests a Cloud-Break Procedure (CBP) implementation as the most suitable option. The main subject of this paper is a proposal of a CBP concept including a design of the procedure and specification of key legislative conditions that need to be met for CBP implementation in actual operations.

KEY WORDS
Cloud-Break Procedure
near-sea aerodromes
Radio Mandatory Zone

Sažetak

U radu se predlaže izrada Cloud-Break postupka za aerodrome blizu mora, priobalne i otočne VFR aerodrome kako bi se poboljšala njihova dostupnost za kombinirane VFR/IFR letove. U prvom dijelu rada istaknuti su trenutačni nedostaci kombiniranih letova iz VFR aerodroma. Analiza koja slijedi bavi se mogućim opcijama koje bi dovele do poboljšanja trenutačne situacije te se predlaže provedba Cloud-Break postupka kao najprikladnije opcije. Glavna je tema ovoga rada prijedlog CBP koncepta, uključujući izradu postupka i specifikaciju ključnih zakonskih uvjeta koji se trebaju ispuniti za provedbu CPB-a u stvarnim operacijama.

KLJUČNE RIJEČI
Cloud-Break postupak
aerodromi blizu mora
područje obvezne uporabe radiouređaja

1. INTRODUCTION / *Uvod*

The situation of conducting IFR flights from uncontrolled VFR aerodromes has been unsatisfactory for many years in the whole world and specifically in Europe. Aerodromes, aircraft operators and General Aviation (GA) community have addressed this problem for a long time, however little progress has been achieved so far.

At present state, only combined VFR/IFR flights are conducted from VFR aerodromes and the change of flight rules is done en route, above the minimum radar vectoring altitude (MRVA), which poses very high demands on good meteorological conditions necessary for successful conducting of such flights.

There is an argument, that uncontrolled aerodromes are by their nature designated to VFR traffic only and operation under IFR rules in their airspace is a controversial idea posing many safety issues such as collisions and controlled flight into terrain (CFIT) or restrictions to other GA traffic (gliders, microlight aircraft, etc.) [1], [2]. Although these reasons may seem sound and fair, the improvement in navigation and surveillance technologies over the last years has brought new options, which provide us with alternative methods to approach this issue. [3], [4] Therefore, many countries in Europe and all over the world are gradually implementing procedures for IFR operations at uncontrolled aerodromes. Most of them use conventional approaches constructed for IFR equipped and certified runways, some aerodromes however implemented procedures which only serve the crew to safely descend closer to the ground (below MRVA) for the purpose of easier transition to VFR. These procedures are commonly called Cloud-Break Procedures (CBPs). The main advantage of CBPs is that they do not require expensive ground equipment (mainly IFR certified runway) because they are not conventional approach procedures. CBP can be designed practically anywhere, and although, with respect to terrain and airspace restrictions, the minima for latest VFR transition may differ, they still provide a significant improvement over the current situation in Europe.

Some VFR aerodromes currently equal the number of movements of IFR ones, but for specific reasons they cannot obtain the IFR status. This may be caused e.g. by geographical conditions or financial demands, but nonetheless it may be an important transport hub for the adjacent city or the region. Any aerodrome in badly accessible areas is a perfect example of an aerodrome where CBP implementation would greatly improve safety and aerodrome accessibility in deteriorated meteorological conditions, requiring just a marginal financial investment compared to an implementation of a conventional approach.

The goal of this study was to design a concept of operation, analyse potential safety issues and restrictions brought by its implementation and finally to evaluate the current regulation background and propose potential changes necessary for the procedure implementation.

[1] VFR – visual flight rules, pravila vizualnog letenja
[2] IFR – instrument flight rules, pravila instrumentalnog letenja

2. CURRENT PROBLEMATICS OF IFR OPERATION AT UNCONTROLLED AERODROMES / *Aktualni problemi IFR operacija na nekontroliranim aerodromima*

At present state, departures and arrivals to uncontrolled VFR aerodromes have to comply with visual flight rules. Transition to IFR is done during the en route climb, no sooner than reaching the MRVA, for departing flights. Respectively, arriving IFR flights have to change to VFR not later than in MRVA during descent. [5], [6] If Visual meteorological conditions (VMC) cannot be maintained when reaching MRVA, the flight may continue at this altitude above the aerodrome and if the crew is still unable to proceed visually a flight to an alternate aerodrome should follow.

2.1. Minimum Radar Vectoring Altitude / *Minimalna apsolutna visina radarskog vektoriranja*

The problems of the procedure described above are caused by the very nature of MRVA. This is the lowest altitude, expressed in feet above mean sea level (AMSL), to which a radar controller may issue aircraft altitude clearances during vectoring or direct routing. MRVA always ensures a minimum obstacle clearance (MOC) of 1000 ft. This means that MRVA is determined from the highest obstacle in the area, to which an MOC increment of 1000 ft is added. The sectors of the same MRVA may be quite large and altitude is always derived from the highest obstacle in the entire sector. As a result, MRVA is usually much higher over the terrain than is the required MOC of 1000 ft. The difference between aerodrome reference point (ARP) and MRVA can be thousands of feets, meaning that the departing/arriving IFR traffic has to maintain VFR and VMC up to e.g. 2000/3000/4000…10000 ft above ground level (AGL). These meteorological conditions are well above the VMC minima for a standard VFR flight. It sometimes leads to absurd situations when IFR transition is impossible due to a low cloud base (literally in all cases of Broken and Overcast below MRVA), however the flight can be planned and conducted under VFR, complying with VMC of airspace class G or E. This contradicts the sole purpose of an IFR flight, which is meant to increase safety of flight in deteriorated meteorological conditions by allowing a flight to instrument meteorological conditions (IMC) in higher flight levels and with ensured traffic separation.

2.2. Possible Solutions / *Moguća rješenja*

There are basically two options on how to improve the current state. The first one proposes an investment into construction of an IFR certified runway with conventional approach and departure procedures. This idea is inspired by the German system, which allows IFR operation at uncontrolled aerodromes providing they have required certification and equipment. [7] Arrivals and departures are conducted in airspace class E and G. Separation between IFR flights in class G is ensured by only one aircraft being granted an IFR clearance in the sector at a time. Furthermore, a radio mandatory zone (RMZ) is established around the class G airspace where the IFR flights are conducted, ensuring that all traffic in the zone will be present on the frequency of aerodrome flight information service (AFIS). This system is efficient, safe and has been in use for a long time in Germany [7], but it requires an extensive financial investment along with an approval of the public (environmental impact assessment study, etc.). In many cases, however, aerodromes do not have resources for such a project.

The second possibility is to implement a Cloud-Break Procedure to allow an easier IFR/VFR transition and increase the aerodromes accessibility. The financial investments would be marginal in comparison to the first scenario because CBP would not require a recertification of aerodrome for IFR operations. The implementation would however call for some operational changes especially in airspace structure, planning and coordination with Air traffic control (ATC).

An important step for the possibility of a CBP development has been a recent change in the definition of a non-instrument runway according to the ICAO's Annex 14 standard[1]. The updated definition says that the non-instrument runway is „intended for operation of aircraft conducting visual approach procedures or instrument approach procedures to a point from which the approach may continue in VMC". [8] This update has allowed a CBP development and its utilisation for the uncontrolled VFR aerodromes.

3. CLOUD-BREAK PROCEDURE CONCEPT / *Koncept cloud-break postupka*

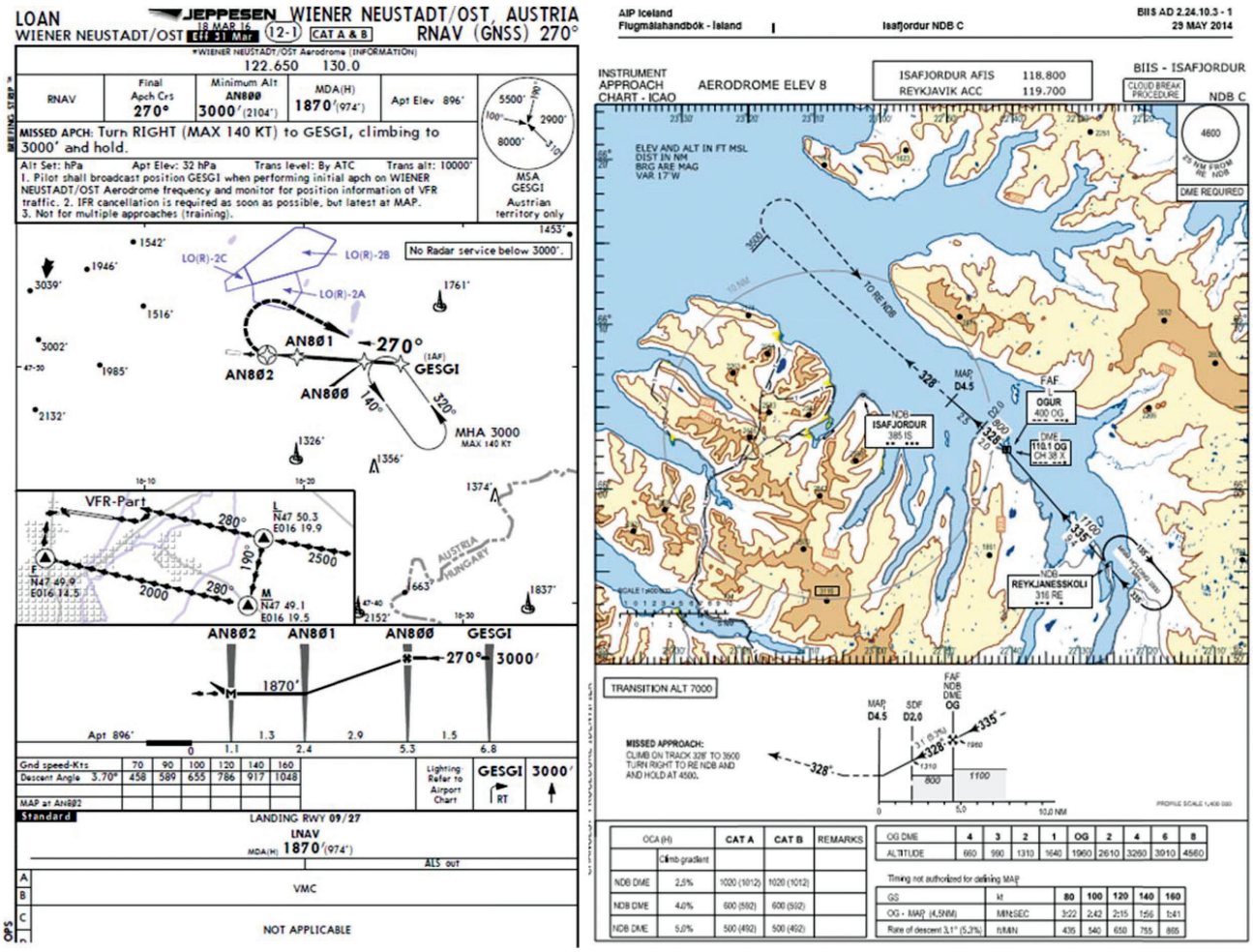
The main ideas for the CBP design are inspired by the procedures already used on some aerodromes in Europe, namely Iceland and Austria. The main reason for this is that the legislative environment is EUROCONTROL[2] and EU compliant [9], [10], [11], [12], [13], which would make the implementation process easier in any other European country. Figure 1 shows the chart of CBP based on satellite navigation at inland aerodrome Wiener Neustadt (LOAN) [14] and CBP based on non-directional beacon at coastal aerodrome Isafjordur (BIIS) [15].

Figure 2 shows a general CBP concept. The procedure consists of an initial, intermediate (depending on operational conditions this segment could be left out), final and missed approach segments. Standard terminal arrival routes (STARs) are considered unnecessary and undesirable since the density of the traffic is not expected to be very high at intended aerodromes and the construction of STARs would further increase the complexity of airspace. Minimum descent altitude (MDA) for latest IFR cancellation may be influenced by a number of various local factors (terrain and obstacles, other airspace and operational restrictions, etc.), but it should never be lower than 500 ft, as this is the minimum height in which a VFR en route flight shall be conducted. [5] Radio-mandatory zone should cover the part of class G airspace, where IFR presence might be expected, i.e. for case where class G reaches to 1000ft AGL, all parts of the procedure with flight path at or below 1000ft AGL, etc. The procedure should be based on satellite navigation, for its availability and low operational costs.

CBP procedure is the solution for any VFR aerodrome, which wants to operate more traffic in deteriorated meteorological condition. The great potential in CBP introduction impact and benefits are for aerodromes with difficult meteorological conditions, which can be found primarily in coastal and coastal mountainous terrain. For other aerodromes, this great benefit will be limited. Because of the local knowledge, we tested proposed CBP concept at one uncontrolled Czech aerodrome named Benesov airport.

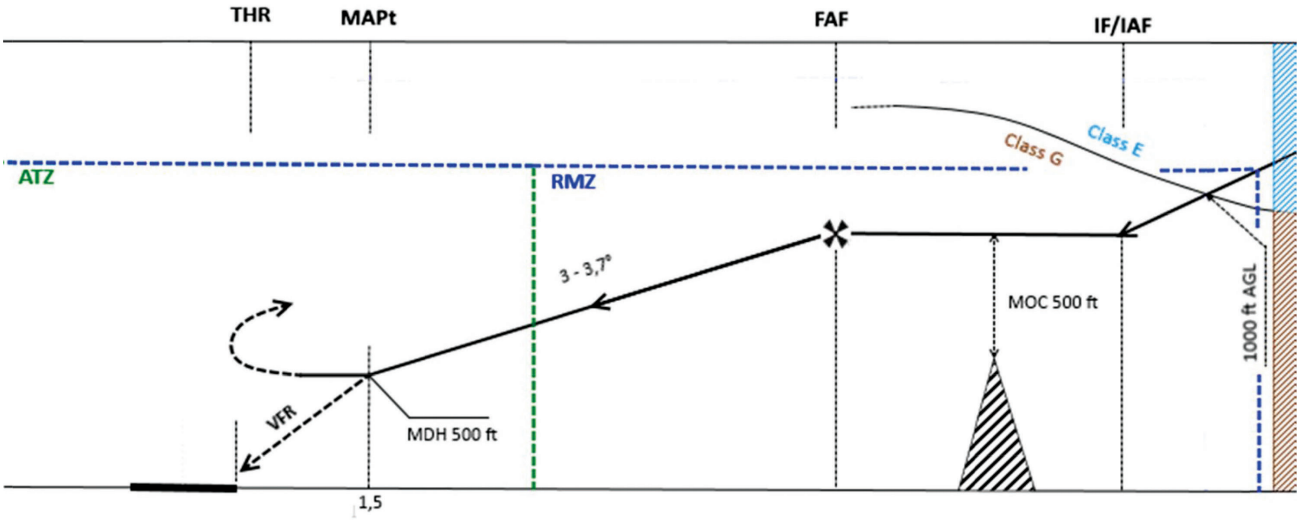
[1] ICAO is International Civil Aviation Organization / Međunarodna civilna zrakoplovna organizacija

[2] EUROCONTROL is European Organisation for the Safety of Air Navigation / Europska organizacija za sigurnost zračne plovidbe



Source: [15], [16], EUROCONTROL

Figure 1 Examples of CBPs in Europe
Slika 1. Primjeri CBP-a u Europi

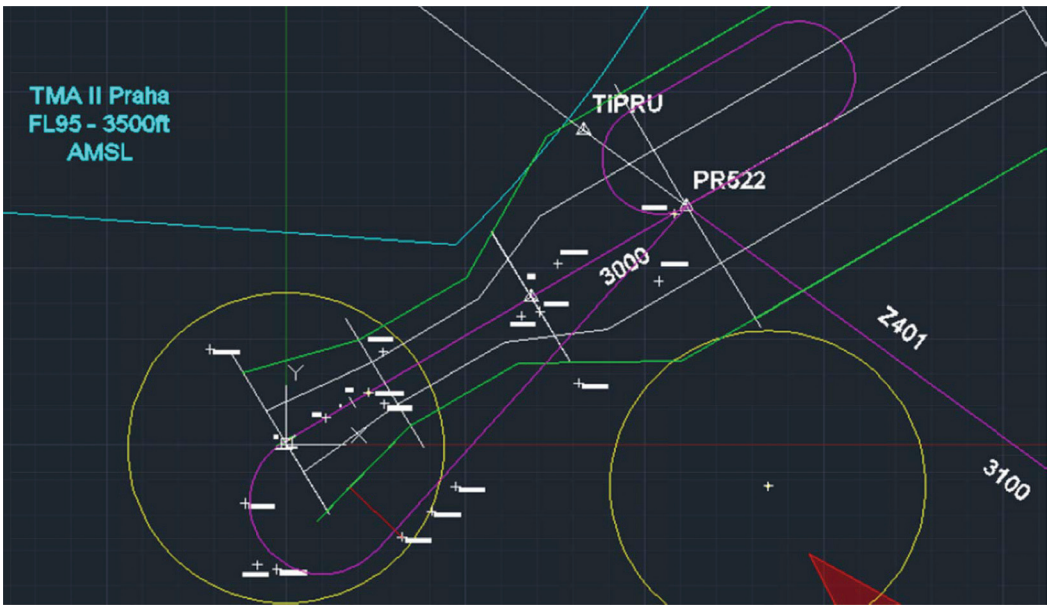


Source: Authors

Figure 2 General CBP concept
Slika 2. Opći CBP koncept

4. CBP DESIGN / *Izrada CBP-a*

The procedure design has to comply with the ICAO Doc 8168 vol II [17], which sets the criteria for construction of visual and instrument flight procedures. The project has been simulated in the AutoCAD 2012 software. Due to the transformation of a coordinate system from spherical to cartesian and due to measurement inaccuracies, the resulting errors are in range of tens of minutes (angular precision) and in range of tens of



Source: Authors

Figure 3 CBP specific design for Benesov Airport
Slika 3. Izrada CBP-a posebno za zračnu luku Benesov

meters (measured distances).

We designed classical LNAV (Lateral navigation) Approach, shown on figure 3.

As an initial approach fix was selected an already existing waypoint (WPT) PR522, which is a part of STAR for Vaclav Havel Airport Prague and it is also positioned on the Z401 IFR route. This waypoint lies in the prolonged axis of runway (RWY) 24 and approximately 8.6 NM from its threshold, which is a sufficient distance for the intended 3° descend on final approach. To avoid the construction of STARs, holding pattern was used for alignment of aircraft to a final track. The procedure altitude in the intermediate segment was set to 3000 ft, ensuring the MOC of 500 ft. Final approach fix (BE101) is positioned 5.2 NM from the runway threshold. Due to obstacles in the final approach area the MDA had to be marginally increased from the intended 500 ft to 558 ft, which is a negligible difference (MOC for a non-precision final approach is equal to 75 m/246 ft). Missed approach point (BE102) is located 1.6 NM from the threshold, approximately in the position of a final turn of the visual pattern. The initial and intermediate missed approach segments keep the aircraft on a straight track until reaching the Turning Point (TP). An altitude of 2000ft defines TP to ensure a sufficient MOC (50 m) in the final missed approach segment that leads back to the IAF. All approach segments were constructed according to the ICAO Doc 8168 vol. II and except the marginal increase in MDA no other adjustments were necessary. Primary and secondary protected areas are applied for all segments. Figure 3 show layout of the final procedure.

Our design was slightly affected by density of Czech airspace and closeness to Terminal Maneuvering Area (TMA) Praha. [18] For aerodromes in badly accessible areas, this would not be the case as the airspace around the aerodrome will be free.

IFR operation in class G airspace calls for an implementation of a RMZ to ensure the presence of all related traffic on the AFIS frequency. This is now the basic requirement in some of the European countries and it looks like this requirement will be transformed into legislation in the future. To make sure that the RMZ will cover the whole area of class G where IFR might be present and to make it easily recognizable by pilots, its dimensions have to cover the typical area of the ATZ incremented for the final approach segment. Vertical dimensions should correspond to the class G airspace, i.e. currently ground – 1000ft AGL for Czech Republic. The resulting concept of the RMZ for instrument approach to one RWY only is shown on figure 4.

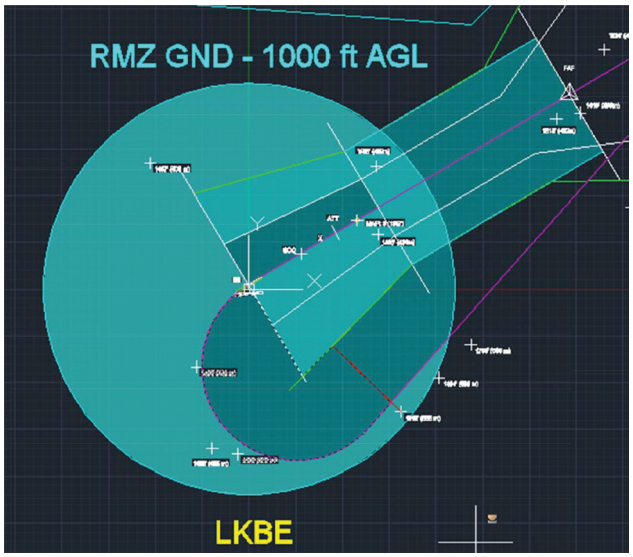


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Figure 4 RMZ for one direction instrument CBP approach at uncontrolled VFR aerodrome
Slika 4. RMZ za CBP pristup na nekontroliranim VFR aerodromima

One of the last areas that need an attention is a definition of the usability of the CBP. Currently, the aerodromes where CBP would be implemented will not have meteorological service and the pilots commencing the procedure would have very little information about the actual weather conditions. One of the options would be to rely solely on the good judgement of an AFIS operator. The other, more professional solution would be to invest into certified equipment that would provide accurate information about atmospheric pressure adjusted to

sea level (QNH), wind, cloud ceiling and visibility as usual in a Meteorological Aerodrome Report of a controlled aerodrome. It would not even require any additional specially trained personnel, as the AFIS officers are also allowed to perform this duty, provided they undertake a special training.

Coordination procedures with the ATC would also need to be updated and published in Aeronautical Information Publication. Finally yet importantly, it is necessary to provide and ensure a proper training of all flight and ground personnel affected by the changes that the implementation would impose.

5. CONCLUSION / *Zaključak*

Implementation of a CBP is technically, formally and legislatively possible in Europe. Today's technologies and systems of navigation and surveillance provide sufficient background for an inexpensive approach design and development of procedures for IFR operation in areas without direct ATC control.

There are no direct legislative obstructions, which would prevent a CBP implementation as proven by the Austrian example. Perhaps the greatest drawback is an absence of a CBP definition in ICAO regulations as a term that would firmly identify the procedure in the legislative environment.

CBP implementation would definitely increase accessibility of badly accessible areas, which has own aerodrome even in deteriorated meteorological conditions, as well as improve safety of operation in adverse weather.

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