# POTENTIONAL USES AND CONSTRUCTION PRINCIPLES OF RNAV NON-PRECISION INSTRUMENT APPROACH PROCEDURES EMPLOYING THE BASIC GNSS HELICOPTER RECEIVER

**Stanislav Ďurčo – Marek Bobček**

The following report reviews the potentional uses and construction principles of GNSS approach procedures employing the basic GNSS helicopter receiver. This method solves the problem of traffic air ambulance services during instrument meteorological conditions. This system has been successfully implemented in some countries. Unfortunately, it has not been implemented in the Slovak republic territory. The aim of this article is to show that the introduction of this system is simple and affordable. GNSS approach brings to the air ambulance service increase of serviceability and safety of flight crews.

K e y w o r d s: non-precision approach, GNSS, helicopter

## 1 INTRODUCTION

There is not implemented any system allowing approach procedures for helicopters of an air ambulance services during instrument meteorological conditions in the Slovak Republic territory. Helicopters are used only during visual meteorological condition, which greatly reduces the serviceability of air rescue services. Classic radionavigation aids, such as VOR/DME, ILS or MLS can be used only for approach to airports, but not to heliports, which are usually situated near to hospitals. The solution of this problem is the use of The Area Navigation (RNAV) and The Global Navigation Satellite Systems (GNSS).

## 2 APPROACH PROCEDURES

Each approach procedure consists of five different parts.

1. **Arrival** – It is part of the approach procedure in which an airplane descents from an en-route altitude to the altitude in which airplane has to be at a initial approach fix (IAF).
2. **Initial approach segment** – It is sector of the approach procedure, which stars at the initial approach fix and ends at a intermediate approach fix (IF).
3. **Intermediate approach segment** – It is sector of the approach procedure, which starts at the intermediate approach fix and ends at a final approach fix (FAF). In this section of the approach a configuration of the airplane should be prepared to enter to a final approach segment. The intermediate approach segment should be straight and without any descent gradient. Descent gradient up to 10% can be used during GNSS helicopter approaches if it is necessary.
4. **Final approach segment** – This sector starts after passing of the final approach fix. The airplane is in a landing configuration and it descent until the airplane reaches a missed approach point (MAPt). The last segment of the approach starts in the missed approach point.
5. **Missed approach segment** – The airplane can not continue in descent after passing the missed approach point, if a pilot has not required visual references with ground. The pilot of the airplane has to commence a missed approach procedure, which is published in a approach chart. In case that pilot has required visual references, he is authorized to finish landing.

There are two kinds of approach procedures:

**- non-precision approach –** Only a horizontal guidance is provided during this kind of the approach. The pilot uses an barometric altimeter to altitude check.

**- precision approach** – A horizontal as well as vertical guidance is provided during this kind of the approach.

## 3 B-GNSS APPROACH

It is financially accessible to use basic GNSS receivers for non-precision approaches of helicopters to hospital heliports. For such action is necessary to approach the helicopter equipped only with basic GNSS receiver and standards instruments for VFR flights. The receiver must be certified by one of these rules:

- TSO/ETSO C129a - Class A1, or
- TSO/ETSO 145a, or
- TSO/ETSO 146a.

Pilots must be trained to perform GNSS approaches and also must be familiar with cockpit equipment and system procedures.

## 4 CONSTRUCTION PRINCIPLES

Principles of construction approach procedures can be found in DOC 8168 - Volume II. Procedures for Air Navigation Services. There are set requirements for each approach segment, which must be satisfied during construction of the approach procedure. DOC 8168 – Volume II. sets that each approach procedure has to start at minimum sector altitude. Minimum sector altitude is set in circle with a radius of 25 NM with the centre at a

heliport reference point. Minimum obstacle clearance height is 1000 ft in this circle.

**Table 1 Initial approach segment requirements**

| MOC | Length | Optimal descent gradient | Ground speed |
|---|---|---|---|
| 1000 ft | < 10 NM | 6,5 % | 90 – 120 kts |

Descent gradient can be increased up to 10% if it is necessary. Maximum value of the descent gradient can be 13,2% but just in case that ground speed is reduced to 90 kts. Maximum heading change at the intermediate approach fix should be 120°.

**Table 2 Intermediate approach segment requirements**

| MOC | Length | Optimal descent gradient | Ground speed |
|---|---|---|---|
| 500 ft | 2-10 NM | 0 % | 90 – 120 kts |

Maximum heading change at the final approach fix should be 60°.

**Table 3 Final approach segment requirements**

| MOC | Optimal length | Optimal descent gradient | Ground speed |
|---|---|---|---|
| 250 ft | 3,2 NM | 6,5 % | 70 – 90 kts |

During final approach segment as well as during initial/intermediate approach segment can be descent gradient increased up to 13,2%, but just in case that ground speed is reduced to 70 kts.

**Table 4 Missed approach segment requirements**

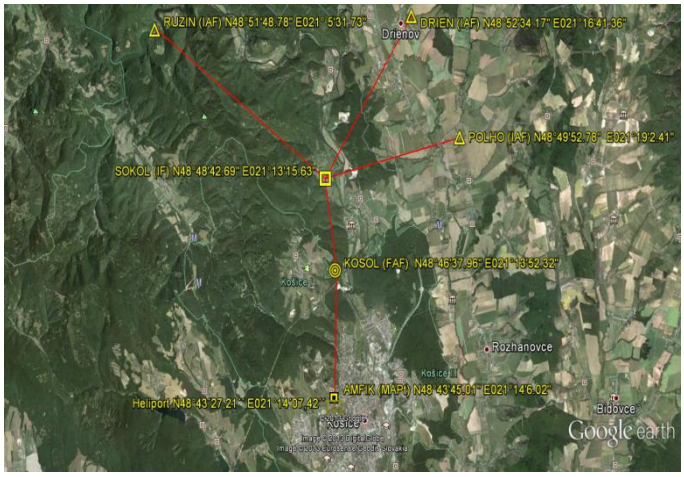
| MOC | Optimal climb gradient | Ground speed |
|---|---|---|
| 130 ft | 4,2 % | 70 – 90 kts |

## 5 CONSTRUCTION OF THE NON-PRECISION APPROACH

Based on the above principles for GNSS approach is possible to design and implement approach procedures for specific hospital heliports. As an example we can mention design structures GPS approach for heliport FN L. Pasteur Kosice. The heliport is used daily by air ambulance, but its use is limited only to visual meteorological conditions. The implementation of the GPS approach can increase uptime of the air ambulance and the safety of the helicopter crews.

| | | | |
|---|---|---|---|
| IAF | DRIEN | N48°52´34,17´´ E021°16´41,36´´ | 4 900 ft ALT |
| | RUZIN | N48°51´48,78´´ E021°05´31,73´´ | 5 500 ft ALT |
| | POLHO | N48°49´52,78´´ E021°19´02,41´´ | 4 900 ft ALT |
| IF | SOKOL | N48°48´42,69´´ E021°13´15,63´´ | 4 000 ft ALT |
| FAF | KOSOL | N48°46´37,96´´ E021°13´52,32´´ | 3 700 ft ALT |
| MAPt | AMFIK | N48°43´45,01´´ E021°14´6,02´´ | 1 120 ft ALT |

Final approach segment is designed with heading 177°. The descent gradient in this sector is 13,2%. It means that the maximum allowed value is used in this design. The ground speed is reduced to 70 kts. If the pilot has not required visual reference, he has to start missed approach procedure at AMFIK. The minimum descent height is 300 ft.




**1 Construction of the GPS approach to heliport FN L. Pasteura Košice**

## 5 CONCLUSION

It is a pity that the world advanced global navigation systems does not have their uses for non-precision approach of helicopters in the Slovak republic territory. GNSS provides many design options of instrument procedures such as standard instrument arrivals and departures.

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AUTHOR(S)´ ADDRESS(ES)

Bobček Marek, Bc., marek.bobcek09@gmail.com
Stanislav Ďurčo, Ing., PhD., stanislav.durco@tuke.sk