OPTIMIZATION OF FLIGHT ROUTES IN THE SLOVAK REPUBLIC

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The introduction contains classification of the Slovak Republic´s air space and its horizontal and vertical division. The main body consists of analysis of the factors that can influence the location of flight routes. This will cover subjects such as restricted areas, danger areas, temporarily segregated areas or protected natural areas. The task of this thesis is to optimize the Slovak Republic flight routes, i.e. to analyze their location and if necessary to correct these flight routes. Therefore, the conclusion will focus on suggestions for changes in the deployment of the Slovak republics flight routes.

K e y w o r d s : Flight Paths, Flight Tracks, Air Space, Optimization

1 INTRODUCTION

The International Civil Aviation Organization (ICAO) since 1945 records the statistics of aircraft accident and evaluates airline operational safety. According to these statistics 507 people had died in aircraft accidents in 2011 which is the second best result since the beginning of the compilation of these statistics. However, a paradox is that as a consequence of emission being discharged into the air more people die than by the actual aircraft accidents. A group of experts led by Steven Barreto, an aerospace engineer from the Massachusetts Institute of Technology in Cambridge, had been gaining knowledge about emission issues during flights especially on the route North America – Asia. The presence of pollutants in the atmosphere, combustion of gasoline and individual emission rate were recorded into the computer. Subsequently they investigated the hitting points of these pollutants and reviewed the selected places. A group of scientists estimated that 8,000 deaths were caused by flying planes and the remaining 2,000 were caused by take-off and landing. From these facts it is clear that although air travel is the safest mode of transport, emissions from aircrafts have very adverse health effects, therefore it is necessary to deploy the flight path to have the least impact on people living in the their neighbourhood and the environment as a whole.

The first part of the article includes a division of the airspace and factors that must be respected and taken into account when determining flight routes. In the second part of the article the designated areas of the Slovak Republic airspace that play the greatest role by “constructing” the flight paths are defined and listed. The third section describes additional factors that are in the thesis by the optimization of flight routes taken into account and are given special emphasis. These are national parks. In the fourth part flight routes of the Slovak Republic air space, their trajectory, use, limiting factors and layouts of their optimization are described.

2 THE DISTRIBUTION OF AIR SPACE

The airspace in accordance with international rules is divided horizontally and vertically. Horizontal limits of the airspace are often the state borders of countries which are also the boundaries of flight information region (FIR). Vertically FIR is divided into flight levels which correspond with the respective classification class. There are seven of division classes (A, B, C, D, E, F, and G) whereby the service levels and the requirements for aircraft equipment in the lower classes decline. In the airspace of the Slovak Republic classes C, D, E a G are being applied. We can imagine the flight paths being as aerial highways by the building of which it is necessary to respect various rules and restrictions and to ensure public safety, critical infrastructure and environmental protection. Among factors that have to be taken into consideration when constructing these “highways” are especially prohibited areas, restricted areas, national parks and bird migration.

3 PROHIBITED, RESTRICTED AND DANGER AREAS

Prohibited area is a determinate airspace in which air activities are prohibited. In the Slovak

Republic this category includes three objects, namely:

- Mochovce nuclear power plant
- Duslo Šaľa factory
- Jaslovské Bohunice nuclear power plant

Restricted area is a determinate airspace where flight activity is limited in accordance with specified conditions. This category includes military training areas and firing ranges, namely:

- Field practice area Veľké Ozorovce
- The Department of Special Health Care and training of the Ministry of Defence of the Slovak Republic Lešť
- Military training area Turecký Vrch and others

Danger area is a determinate airspace where activities dangerous for aircrafts could be performed at a specified time. The only area in the Slovak Republic that is classified as a danger area is the space above the training area Sklenené. In Sklenené the practical training course of troop pyrotechnics that provides appropriate education for pyrotechnics of the Armed Forces of the Slovak Republic is being performed.

4 NATIONAL PARKS

In the Slovak Republic there are more than 1,000 protected areas with an area of nearly 10,000 sq km. A certain degree of legal nature and landscape protection is applied on more than a fifth of the Slovak Republic. In Slovakia there are 9 national parks. Many plants and animals living in the Slovak Republic are protected. Protected are complex areas, among which the most important are national parks, protected landscape areas and natural reserves. The national parks in Slovakia are:

- The Slovak Paradise National Park
- The National Park of High Tatras
- The National Park of Malá Fatra
- The National Park of Muránska Planina
- The National Park of Low Tatras
- The National Park of Slovak Kras
- The National Park of Pieniny
- The National Park of Poloniny
- The National Park of Veľká Fatra

5 FLIGHT ROUTES IN THE AIRSPACE OF THE SLOVAK REPUBLIC

ATS is a specified route designed for channelling the flow of traffic when needed to provide air traffic services. The term "ATS route" is used in various contexts, including:

- flight path
- advice line
- controlled or uncontrolled route
- arrival or departure route

The airspace of Slovakia includes the following tracks of air traffic services:

Flight track A4 runs from Nitra beacon VOR / DME via the detection point BERVA and FIR BDRY ODNEM in the Czech Republic. In this form, however, the line leads too close to the forbidden area marked LZP29, in which the Jaslovské Bohunice nuclear power plant is present. The ban on flights over this area is valid only up to 1500 m, but in case of a serious defect on the airplane or a destruction caused by the encounter with birds may cause the fall of the aircraft or its debris into the space of the nuclear power plant. In this case a conflict between at least two critical factors may occur because the bird migration route is here too.

Track A42 begins at the detection point MALBE and continues to track EBENI KOŠICE VOR / DME, EXIDE, DEDIS, TAKOS, TAGOD, WMF, SLIAČ VOR / DME, and ULPIS NITRA VOR / DME. With the help of this track is the Košice Airport connected with the Bratislava Airport and the Praha Airport. Its use interferes into the airspace over The Slovak Karst National Park, that can't be avoided by the flights to Bratislava, but in the case of Praha it is possible to choose an another alternative.

Track B7 is mainly used for connecting the Košice Airport with the airspace of Poland. It starts at the point KOŠICE VOR/DME (KSC), continues to the detection point NOKRI and at the point FIR BDRY LENOV enters the Polish airspace. This track does not require any change because it does not cross with any designated area or national parks.

Track B45 has its trajectory on SLIAČ VOR/DME (SLC) RIMIT, NIDOK, FIR BDRY BILNA. This track with minimum flight altitude of 1920 m (6400 ft) and width 10 km and can be used for connecting the Prague Airport to Košice or Poprad. Track B45 in its present form does not affect any of the premises and therefore does not require any optimization.

Track R23 results from the non-directional radio beacons ŠTEFÁNIK NORTH NDB (OKR) via beacon NITRA VOR / DME (NIT) detection point MOMEP point, NDB beacon DUBOVÉ (DBV), detection point FIR BDRY MEBAN and continues into the airspace of Poland. This flight route is also used for flights between Bratislava and Moscow. The connection between The Airport of Milan Rastislav Štefánik and the capital of the Russian Federation is the proper solution to create a line between beacons ŠTEFÁNIK NORTH and detecting point MEBAN located on the Slovakia - Poland border, this option is not possible at the time when the transiently activated allocated spaces LZTSA 02A and LZTSA 02B serving for military training of the Air Force. Then there is the need of crossing over the mountain range Vtáčnik and also this line crosses the route of bird migration, so it is advisable to maintain the original flight path.

Track R53 with its trajectory SLIAČ VOR/DME, UBARU, EPEDA, TATRY VOR/DME connects the airports of Sliač and Poprad – Tatry. This line may also be used to connect the airports Poprad - Tatry to Prague – Ruzyně. For the flight between these airports there are several alternatives.

Track R232 begins at the point FIR BDRY KEKED and continues at the points KOŠICE VOR/DME (KSC), MARKA, TATRY VOR/DME (PPD) and FIR BDRY LOLKA. This track can be used by the Poprad Airport for flights to Warsaw and Gdansk and for the connection of Košice Airport with Poprad Airport. The track labeled R232 requires no change.

Track W425 connects the detection points FIR BDRY LASOT, GORUP with the beacon KOŠICE VOR/DME (KSC), ie. That it connects Košice Airport with the Ukraine, but since this function is made by the A42 line, I suggest it in order optimizing the flight routs in Slovakia to be cancelled.

Track UB7 has its trajectory very similar with B7 line, but this line is located in the lower airspace (the upper limit is FL 245, while at the same level there is the lower limit of the track UB7). Another difference is that the B7 line runs from the Košice Airport to the detection point LENOV at the Slovakia - Poland border, but UB7 line in the upper airspace is extended from the omni-directional radio KSC to the detecting point KEKED at Slovakia - Hungaria border. According to the fact that The International Airport of Ferenc Liszt in Budapest, operates flights to many northern destinations including Oslo, Gothenburg, Stockholm, Helsinki and Turku, UB7 track is suitable for these flights.

Track R53 connects the points SLIAČ VOR/DME TIVON and TATRY VOR/DME. Its trajectory is identical with the trajectory of line R53, which is located in the lower airspace. According to the fact that the Low Tatras are situated here it is preferable to use the route in the upper airspace, which has its lower limit FL 245. Therefore its optimization is not required.

6 CONCLUSION

Analysis of flight routes can be done in different ways, using different parameters. For the purpose of the work the most viewed criteria have been selected, that are currently mainly safety and environmental protection. Therefore any changes or building new facilities are not taken into consideration (radiobeacons, detection points, etc.) but only economically less demanding criteria are important. With this background, it is possible to conclude that it is necessary to optimize two of the selected tracks, track W425 and A4. The result of optimization is a new track, which connects the Airport Poprad with the Airport Ružomberok and the detecting point BILNA.

The reason for changing the track A4 is the fact that it is located near the Jaslovské Bohunice nuclear power plant, which is potentially dangerous as to the nuclear power plant, so to the population and environment. Another change is the shift of the line to the detection point ERGOM, forming a through flight line between Hungary and the Czech Republic.

The reason to optimize the line W425 is the fact that its role, the connection with the Košice Airport and the airspace of Ukraine provides line A42. In addition, this area is a bird migration route, which crossing with two flight paths increases the likelihood of bird collisions with aircraft.

Track Poprad - Ružomberok - BILNA was designed to connect airports Košice and Poprad with Prague. This track is only applicable at the time when the space LZTSA05B is not activated. Its advantage is that from the track Košice - Sliač - BILNA is shorter by about 28 km from the track Košice - Nitra – MAVOR, even by 77 km. Its disadvantage is that it is not always usable and partly extends into the High Tatras.

The distribution of air routes in the airspace of the Slovak Republic is in the picture (Fig.1). In black lines tracks are highlighted that were not changed during the optimization, in green new tracks are highlighted and in gray tracks of flight routes are highlighted, which have been modified or completely revoked.

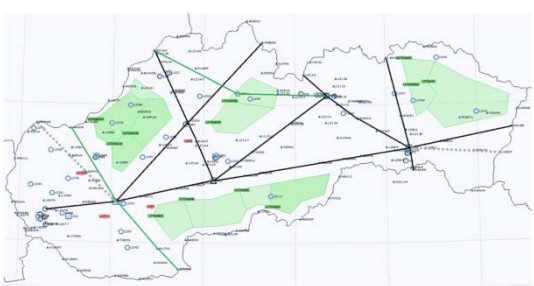

Fig. 1

Finally, it is necessary to point out that by another way of defining the parameters of optimization other conclusions could be reached than those referred to in this work.

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