# THE TECHNICAL PROTECTION ENERGY, RADAR AND NAVIGATION AIRPORT EQUIPMENT

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This text specifies the energy, radar and navigation airport ground equipment. It analyses and describes radio navigation and instrument landing systems at the airport Košice. It defines the general requirements for ensuring of their protection and monitoring. It suggests all means and methods used abroad and points out the possibility of their application to airport security and aviation ground equipment. It describes the operation of intrusion control systems and closed circuit television systems. In conclusion it points out the use of intelligent video analysis software with their effective use in terms of reducing power of human labor to ensure the airport security.

K e y w o r d s: Airport security, fence, surveillance radar, intrusion control system, CCTV

## 1 INTRODUCTION

The safety of air traffic is dependent on a number of measures, to a large extent to include the airport security of aviation ground equipment. Since November 23th, 2006, a fence must be provided on an aerodrome to deter the inadvertent or premeditated access of an unauthorized person onto a non-public area of the aerodrome. Containing measures and procedures for the protection of radar and navigation equipment at the airport is to prevent the entry of undesirable persons on the ground, to avoid damage to equipment and not degraded their activity. Security is ensured by measures to control and monitor the movement of people around the equipment and installing intruder detection that ensures the continuous monitoring and security devices form an additional barrier to the mechanical as well as informative measures; such as the installation of warning signs to alert to people of dangerous microwave radiation.

## 2 ENERGY AND RADIONAVIGATION EQUIPMENT

The electrical equipment of airports is characterized by a large number of energy-intensive equipment, the performance and quality of energy supply, the extensive supply network and the continuing growth of new, often large consumption of electricity. The supply system is a complex, which is powered by one or more external power sources and an extensive distribution network consisting of transformers and distribution points. Airport electrical systems must be designed and installed so that in the event of failure to supply airport visual and radio navigation equipment, the pilot will be provided with adequate visual and non-visual guidance without misleading information. Equipment for which the required source of backup power, should be adapted to the case of failure of the primary power source to the equipment switch to an alternative source.

Group navigation devices are the most diverse of technical equipment and have a long history. These intricate devices provide positional information directly to the crew and there are located on the ground. Means for landing and takeoff of aircraft are divided into visual and non-visual. Visual means provide guidance in the last phase of the aircraft approach and landing. Non-visual navigational means in the Slovak Republic are the property of Air Traffic Services that is responsible for their operation, introduce here facilities for precision instrument landing system.

Radar is a radio-electronic device that is capable of detecting identified targets and their position in space via electromagnetic waves. RADAR is an English acronym for RAdio Detection and Ranging. The primary surveillance radar is one of the most widely used radars in civil aviation. It operates on the principle of the reflected signal from the target, which is then evaluated by radar, as opposed to secondary radar, in which a broadcast signal is activated by special equipment and sends a new signal.

## 3 SPECIFICATION RADIONAVIGATION AND INSTRUMENT LANDING SYSTEM AT THE AIRPORT OF KOŠICE

### 3.1 The Instrument Landing System - ILS

The Instrument Landing System (ILS) is an internationally normalized system for the navigation of aircraft upon the final approach for landing. The most dangerous phase of flight and landing, given the ILS system for high demands for accuracy and reliability and is based on modern technology with extensive possibilities of remote monitoring and maintenance.

The ILS ground system consists of three subsystems:
- VHF localizer transmitter - LLZ
- UHF glide path transmitter – GP
- VHF marker beacons – MRK.

For the purpose of discontinuous addition of navigation data with the value of a momentary distance from the aircraft to the runway's threshold, the following marker beacons are used:
- Outer Marker OM,
- Middle Marker MM,
- Inner Marker IM.

The system of marker beacons can however be complemented for a continuous measurement of distances with the DME system (Distance measuring equipment), while the ground part of this UKV distance meter is located co-operatively with the descent beacon that forms

the glide slope. It can also be supplemented with a VOR system by which means the integrated navigational-landing complex ILS/VOR/DME is formed.

## 3.2 Very High Omnidirectional Radio Range - VOR

Very High Omnidirectional Radio Range VOR- is a device to navigate for short distances up to 300-400 km. An antenna system ground beacon sends a carrier signal with its two separate 30 Hz modulation components. The directional system sends a signal to the variable phase and the non-directional system sends a signal to the reference phase. The on-board part of the VOR indicates the aircraft a course to land of the radio beacon. It is the angle between the lines joining plane - beacon and beacon-north. Furthermore on-board devices can read any deviation from the set course, information about the direction of flight, or the flight from or to the beacon.

## 4 GENERAL REQUIREMENTS FOR THE SECURITY

Responsibility for ensuring the spatial and perimeter airport security is provided under applicable laws and regulations and in accordance with SR standards, EU, ICAO and EASA guidelines. The airport security and movement areas it specifics are addressed in the airport safety program, in the airport operations manual and in the transport policy of airport and internal guidelines.

Airport security is a set of safety, mechanical, technical and elementary measures that are intended to prevent attacks on persons, aircraft and airport and subsequently prevent the establishment of activities that tend to the violation of schedule.

Protection system and airport security consists of the following basic types of protection:

- Classical-mechanical: a security fence is a base type of protection, defines a protected area and is designed to deter and detain intruders.
- Physical: protection system or security system, integrates people, procedures and/or equipment for the protection of assets or facilities against theft, sabotage, and other malevolent human acts. Its aim is to identify suspicious behaviour, identify vulnerabilities, and deter persons from committing acts of unlawful interference in the civil aviation.
- Technical: there are two main tasks: supports traditional mechanical protection and increases the effectiveness of physical protection.
- Regulations: these are a summary of the administrative and organizational measures.

Airport fencing must be compact around the perimeter and must clearly set out the boundary that will separate the non-public area (airside) from areas designated for public (landside). Crossings across the border must be controlled and monitored by guarded entrances. Fencing and other barriers must be applied to air ground equipment outside the airfield, as specified by the aviation airports prescription L14 Airport, volume I.

## 5 PROPOSALS FOR TECHNICAL PROTECTION OF THE AIRPORT

The technical tools and intrusion control system helps to ensure the protection of the area. They make it easy and, often as well, indirectly replace humans. Intelligent software is monitored and evaluates the situation based on pre-specified criteria for activating the alarm.

Reliable solutions from Bosch Security Intrusion control system is based on the use of reliable high quality sensors that use advanced technology of motion detection. These sensors provide maximum protection against unauthorized intrusion and offer an unrivalled ability to process signals. If the detector records a disruption, CCTV cameras capture a high definition recording which is processed through intelligent image analysis software, to verify the alert and possibly allow a forensic search, identification of the intruder and eventually his arrest.

### 5.1 Closed Circuit Television

Closed Circuit Television is used for live viewing and recording at the same time, out of the guarded zone. It is used for continuous monitoring, but also as a supplement for intrusion detection, which is activated if/when a violation of the monitored area occurs.

Currently analog cameras are still being used, which are supplied to the network via digital encoders, but for better results digitized video signals are transmitted over the Internet wired and wireless networks using the IP protocol. To ensure reliable operation of the camera system, all transmissions can be realized through optical fibbers. Special types of cameras can be controlled directly from a computer and some types are able to zoom the image.

### 5.2 Aegis SuperLED lighting

For quality recordings from the cameras, it is necessary to provide direct floodlights in the shooting area. Aegis SuperLED lighting is designed to optimize the performance, night cameras are equipped with 3D diffuser technology, which effectively "daylights" the territory and covered background.

Figure 1 Aegis SuperLED lighting

LED lightings with infrared and visible white light are intended for short-range and remote monitoring up to 320 m. They are long lasting, being maintenance free for up to 5 years. They are ecological, ensure energy-efficient operation are therefore are environmentally friendly. Infrared options allow discreet monitoring and do not cause light pollution. White light with a quick start and efficient operation in conjunction with PIR detector is a safe lighting in areas of movement of persons and vehicles. Lighting design is durable, all the same operates discreetly.

### 5.3 Thermal IP Camera VOT-320

Fixed thermal IP camera - VOT-320 Thermal IP Camera from Bosch is designed for exterior use and is capable of detecting more than ordinary cameras. It can operate in complete darkness, as even adverse weather conditions such as snow, fog or dense smoke do not impact on its efficiency. It has intelligent image analysis, which offers digital imaging, including line crossing, entry into secured areas, tracking trajectories and a freeze feature which stops the video thereby providing the security personnel with a quality visualization scene. These cameras offer high-quality images transmitted over the network in less than 2 seconds, which is the ideal solution to protect airport security. Overall reliability of the system in case of network failure increases also additional slot for micro SD card.



Figure 2 Thermal IP Camera VOT-320

### 5.4 Software systems

No matter how few or how many cameras your CCTV uses, monitoring everything effectively presents a serious challenge. Even observing just a single screen for long periods pushes concentration to the limit – after only 20 minutes, an operator can miss as much as 90% of the activity in a scene. Today's modern technologies are beneficial and provide support for security personnel in monitoring the protected zone. Such systems include for example, Intelligent Video Motion Detection and Intelligent Video Analysis. Video management system from Bosch offers a safe solution for IP-based protocol for large companies, which includes the support and cooperation of Bosch CCTV management products. This system allows the integration of existing components into a single configurable system, monitoring of live and recorded video, anywhere on the network.



Figure 3 Intelligent Video Analysis

### 5.5 Perimeter protection - technical devices

Proposed new types of fencing systems have been designed according to ICAO standards in terms of security Aerodrome Design Manual, Part 6 – Frangibility and airport standard L14 Aerodromes Design/Operations, Volume I.

*EXEL Fragile* fence consists of panels made of fiberglass tubes. It is available in two widths of 1.0 and 2.0 m with free spacing 90 mm at 1.9 m. Gates are available in single or double configuration. Standard colouring for fencing is yellow or orange, other colours are available upon request.

*FIBRE NET- FRP* (fibre-reinforced polymer) radio transparent fences can be used in sensitive airport areas, both internal and perimeter, and have been approved and adopted by aviation authorities. An airport fence is generally high consisting of FRP mesh fabric (green), mesh dimension 33mm × 33mm, made of chemically resistant glass fibre impregnated with isophtalic polyester resin.

Typical characteristics of the FRP fences produced by Fibre Net are:
- High chemical and mechanical resistance,
- Electrical insulation and a-magneticity
- Radio-transparency: no interference with electronic control systems (ILS or other)

- No visual interference for the security personnel supervising the surrounding areas
- Good resistance to weathering and UV rays
- Simple installation
- No maintenance needed, even in the long term
- Low-cost when compared with other radio-transparent fencing solutions
- High flexibility in compliance with specific requirements from different customers.

**5.6 Microwave barrier sensor SIRS-255 MBS**

This system is a perfect addition to extend the perimeter protection with a traditional mechanical barrier and CCTV. The SIRS-255 Microwave Barrier with range up to 200 m detects people, vehicles and other objects in terms of distance, velocity and direction of movement. Advanced in-sensor processing minimizes the amount of interference and false alarms. Based on pre-defined threshold values the sensor is able to raise alarms on certain criteria and ignore alarms caused by objects with characteristics not defined as threshold values. Microwave frequency ensures continuous operation, regardless of the weather conditions, especially those that affect visibility such as rain, snow and fog. Furthermore, the system 255 SIRS is completely independent of the lighting conditions, such as sunlight reflections, light changes and does not require any lighting. It operates autonomously and can make target analysis and raise alerts automatically. The sensor information can be used to direct a video camera, turn on lighting and call an emergency service centre.

Figure 4 SIRS-255 MBS

**5.7 Blighter B400 Series Radars**

Blighter radars are ground surveillance radar with a long range. It scans and detects moving vehicles and persons, including 'crawlers over a wide area and provide exceptional detection performance out to 32 km. Detected targets are reported via wired or wireless network connections, allowing target recognition and identification through the automatic slew-to-cue of optional cameras or thermal imagers. Accurate positional information is reported, including target latitude/longitude co-ordinates, range and bearing.

The BlighterView HMI is a complete PC-based software application for displaying and controlling multiple Blighter radar units and associated peripherals

Figure 5 Blighter B400

**6 CONCLUSION**

Ensuring the safety and security of airports is a very delicate question and details of them are subject to confidentiality. The basic requirement is to prevent dangerous items and unwanted people infiltrating the space in the airport or on board an aircraft. Ensuring safety is assessed in relation to the protection of the airport perimeter, aircraft operational safety and security equipment, terminals and facilities, restriction of movement on operational areas, security checks of passengers and employees.

Human supervision is necessary despite all the technical means and intelligent systems. Thanks to these resources and systems, it is not only possible to avoid an unnecessary alert, but on the contrary, to allow for the proper procedure to predict the act of an intruder.

BIBLIOGRAPHY

[1] Standards L14, Airports, I. Volume, Chapter 8 - Aerodrome Design and Operations. Ministry of Transport, Posts and Telecommunications, Second Edition - December, 2006, 240 p., ISBN 80-969299-8-4
[2] The reliable solutions for airports from Bosch Security Systems, [online] Sicherheitssysteme Bosch GmbH, 2010. Available at: http://www.bosch.sk/content/language1/downloads/Bosch_ST_Brochure_Solutions_Airports.pdf
[3] SIRS-255 Microwave Barrier, [online]. Available online at: http://www.saabgroup.com/en/civil-security/air-transportation-and-airport-security/airport-security-solutions/sirs-255-mbs/
[4] B400 Series Radars, [online]. Available at: http://www.blighter.com/images/pdfs/fact-sheets/blighter-b400-series-radar-fact-sheet-def0619.pdf

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