

## ENERGY SAFETY AT THE AIRPORT

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**Summary:** This paper deals with characterise and analyse each possibilities of ensuring energy safety on the airport. Describe primary, secondary, continuously sources of electricity power and switchgears. Demonstrate types of uninterrupted power supplies i.e. on-line, off-line, line-interactive. Also review the automatic monitoring system, which is for monitoring, signalization and control of airport systems and equipment followed by monitoring system GlobMon. Dedicated places for uninterrupted power supplies are also reviewed. Detailed description of equipment specifications, technical documentations and solution methods according to airport demands.

**Keywords:** uninterrupted power supply (UPS), energy safety, monitoring system, reliability system

### 1. INTRODUCTION

Safety in civil aviation is one of the basic and most important quantitative indicators, which have a major quality influence in this type of traffic. Aim of this diploma thesis is to determine requirements of energy safety, review of installing power supplies on airports and analyze practical experience with different types of UPS. New technologies are connected with much kind of industries, which generate a new problem in providing of electrical energy. Devices equipped with UPS are one of the best solutions.

First chapter is describing requirements of energy safety, which is a complex notion. Safety status of country, society and economy in connection with possible deficiency to ensure energy demand and sources in expected quality. Inspection of responsibilities is done by institution of energy inspection SR. Important energy sources are to provide safety operation in aviation. Also describe primary, secondary, continuously sources and switchgears. Second chapter characterize UPS according to output voltage (DC, AC, combined), method of electricity (rotating, static) and other (off-line, on-line, line-interactive). Table of each device equipped with UPS, which are controlled by monitoring systems (AMS, GlobMon). Last chapter is a complex proposal of UPS installation, including possible ways of connections each components according to safety, economic benefit, variability of final setup and model of reliability [1].

### 2 ENERGY SAFETY REQUIRMENTS OF AIRPORT

#### 2.1 Energy safety

Energy safety means reliable supply of energy, ensuring access to energy sources in expected quality and price.

Principles of energy safety:

- diversification of supplying basic energy materials,
- adjustment of actual reality integration,
- importance of information,
- flexibility of energy system

According to law § 65 sec. 1 n. 656/2004 about energy, institution of energy inspection SR is responsible for energy inspection, also for issuing preliminary actions and decisions, recording actions to eliminate identified deficiencies.

## 2.2 Provision of airport electric power supply

Provision of airport electric power supply is important mainly of visual, radio navigational and meteorological equipment.

Power sources are to provide regularity of air traffic:

- Primary power source is usually a public electricity grid.
- Secondary source is alternative power, i.e. diesel generators or UPS, with capacity from 50 to 1000 kVA. Secondary power source has to supply energy for a time period when primary source is out of service.
- Continuously power sources are connections to the public network from two independent sources.
- Switchgears, converters and batteries are for backup power supplies [2].

## 3 BACKUP POWER SUPPLIES AND MONITORING

Backup power supplies are intended to ensure a constant power of important equipment in case of primary power source failure. Power interruption may incur economic losses, damages or loss of life.

Backup power supply types can be divided by:

- output voltage (DC, AC, combined)
- method of electricity (rotation-generator, static-UPS)

The main difference between generator and UPS is the reaction time, UPS can immediately react against generator (30-40 second).

### 3.1 Uninterruptible power supply-UPS

UPS is designed to accumulate the energy in batteries, to overcome short electrical outage and converted to electricity supply network parameters with the inverter. UPS also filter and stabilize electric network.

Overview of UPS voltage margin:

- UPS off-line 0-500 VA,  
also called passive stand-by, the most common type. DC voltage of the battery is changed to stable AC voltage in electronic circuit inverter having a step approximated sinus wave.
- Line-Interactive UPS 0,5-5 kVA,  
similar to off-line UPS, with better surge protection, multistage regulation of the output voltage, better filtering of input, precise method for detecting failure of the input voltage and faster switching to the backup source and back. The main use is to backup servers and computer stations.
- Double conversion On-line UPS 1-5 MVA,  
are used for servers and ICT facilities in server rooms and data centers. UPS uses double conversion filtered electricity drawn from the public electricity grid. Advantage is always the same voltage on the output (stable and clean). Disadvantage is the need for cooling, shorter lifetime and higher price.
- Delta conversion On-line UPS 5-5 MVA,  
used to backup data centers, buildings and industrial applications. Similar to double conversion topology with a difference between the baseline and the required output value of three phase AC power. This difference is balanced by delta inverter, which also controls battery charging and ensures the input power factor correction and input characteristics. In case of internal faulty of UPS is installed a by-pass module. This technology ensures high efficiency, low heat loss, compatibility with all types of generators and reduces the cost of the necessary installation materials and oversizing generators [3].

### 3.2 Diesel generator

Diesel generator is a combination of combustion diesel engine and electric synchronous generator. The engine creates torque and alternator converts kinetic energy into electricity. This unit provides high level of power, reliability, minimal maintenance and affordable cost for wide deployment. They are used in places where it is brought AC power, or power failure is a common [3].

### 3.3 Monitoring systems

Monitoring systems are designed for monitoring, alarm and control of the following airport systems and equipment:

- light signal and security devices of runways
- regulators constant current CCR
- radio navigation systems and airport installations (ILS, DME, NDB)
- route navigation aids and equipment
- energy systems (EES)
- meteorological systems
- protection zones, replacement and backup resources,
- receiving, sending and processing of aeronautical fixed telecommunication network (AFTN)
- emergency procedures for exceptional situations
- operating conditions for all categories of visibility ICAO
- fire and security alarm remote objects
- display data from neighbouring systems,
- evaluation data needs for CAT II and CAT III,
- archiving operating and fault conditions

#### 3.3.1 Global monitoring system – GlobMon ver.5

GlobMon is a perfect monitoring system if power system consisting of UPS, inverters, motor generators, switches, switchgears is large, and for monitoring is necessary to use several incompatible software. GlobMon is designed to collect and evaluate information from different types of devices via various communication interfaces. It helps with orientation of data provided by the facility, and categorizes the information as needed. Given information either via email or SMS communication. Support for protocols such as SNMP (Simple Network Management Protocol) and TCP. Software is based to allow the user to clear and transparent data processing in order to allow fast and accurate analysis of the situation. User can create infinite hierarchical display [4].

GlobMon editions:

- express - basic edition
- professional - including reports and trends
- ultimate - graphical reports and trends

## 4 INSATALLATION PROPOSALS OF BACKUP POWER SUPPLIES

To ensure the airport PSU is required suitable projection of these resources. The proposal is intended to represent possible ways of linking individual components of backup system. UPS systems with a nominal power greater than 10 kVA and with double conversion are available equipped with thyristor rectifier. This connection can result in a very unstable operation of both systems, voltage distortion of generator.

#### 4.1 Analysis, solution

Overlapping state microsecond conduction causes voltage drops, the depth of which is influenced by the size of inductance in the AC rectifier circuit. The main inductance of the circuit is the leakage reactance transformer, rectifier and, if power using diesel generators and transient reactance of the generator. To reduce the depth of these downturns, it is necessary to minimize the reactance of the generator. Solution is overrated or underrated nominal generator power consumption to UPS. Selection of a suitable generator with structurally lower transient reactance also improves performance.

#### 4.2 Reliability research of power distribution systems for important units at the airport

Important units of electricity supply and distribution system are taken from the two networks 10 kV or 35 kV, also belonging to the terminal city mains. In order to ensure the reliability of critical supply units, airports are self-built or replacement power, uninterruptible power supplies. So the structure of important power units is complex and requires high reliability, the reliability of the research must be carried out.

Supply and distribution of vital power unit at the airport are shown in fig. 1. It merely states tower light distribution and navigation station three major powertrain, the rest is the same as connection of three units, all of which are connected in parallel to a line WL. As the relevant drive units parallel to each other, so that the form of this article shows a power distribution system and a significant energy units in the example of the control tower.

Major networks are divided into two generators G1 and G2, and the airport are running in standby mode and operate in parallel. Mains power switches QF1, QF2 and QF3 open, QF5 closed switch contact, low voltage electricity G1 and G2 are enhanced transformer T1 at 10 kV and 35 kV, and with continuation of the relevant units of the airport. QF4 switch high voltage is necessary close, 10 kV or 35 kV high voltages supplied from WL cable, transformer T2 is reduced to 380V / 220V. Then through low switching voltage QF11 it is associated with the button on the control tower equipment. Besides further it needs to ensure reliability of supply. Every important energy unit airports have specialized assembly production, and G3 in Figure 1 provides a low voltage power supply to the control tower using a low voltage switch QF12 directly. [5]

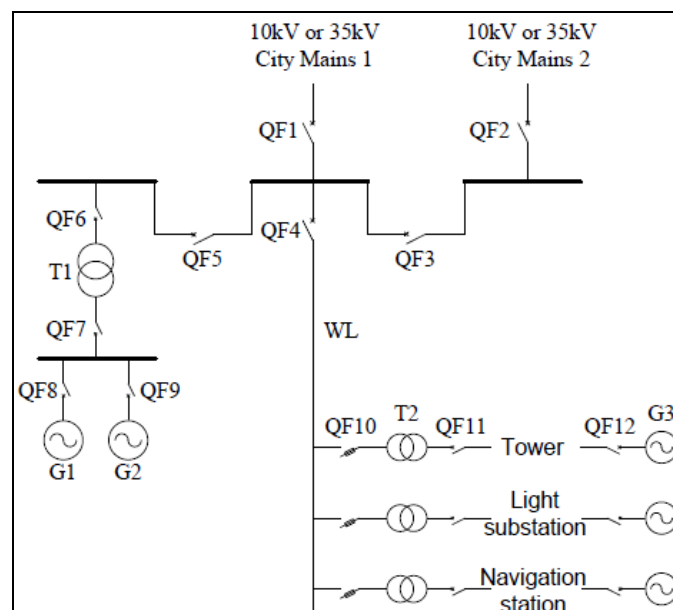


Figure 1 – Scheme of power supply and distribution system critical power unit

#### 4.3 Reliability model of power supply and distribution system critical power unit

Model reliability can be divided into the **basic model of reliability** and **enhanced reliability model**. The basic model of reliability concerns trouble duration, or the likelihood that the product is prescribed conditions. Reflects the desire to maintain a human product. It is used MTBF (Time Between Failures Main) parameter as overall reliability. The basic model of reliability is used to estimate the requirements of maintenance and safety of the product and each of its components. Enhanced reliability model is used to estimate the probability to complete the desired function of the product in the process of performing the tasks described proper role in the process of each unit to complete the task, and is used to measure the effectiveness of the task. Therefore, the reliability of the model extension is set for reliability block diagrams and mathematical models by function and logical relations between them. It shows the relationship between different devices to complete the tasks required reliability of the system, through various series of parallel and hybrid combination of a typical model. Model reliability of the distribution network powertrain includes basic block diagram of reliability and its mathematical model. Block diagram of reliability refers to the scheme of system failure for each component or a combination of functions within the supply and distribution system.

The reliability of each unit is the basis of the overall system reliability. Reliability and failure rate units 1 and 2 can be obtained from the relevant data from the main network. The rest are electrical equipment, their life in general governed by an exponential distribution, and their reliability and failure rate can be obtained from the specifications of the equipment. [6]

#### **4.4 Technical report series UPS DELPHYS DS, MP, MX**

The following facilities are designed for airport traffic services for airports operated continuously for a runway that are equipped with ILS or MLS (Microwave Landing System), visual and navigation facilities. UPS sources are a type of on-line double conversion.

Type of Uninterruptible Power Supplies DELPHYS are made in the configuration with 3-phase input, 1 and 3-phase output with adjustable 380,400,415 V. used to supply energy-intensive installations with an output of 20 kVA - 800 kVA.

Backup sources - DELPHYS series are structurally designed so as to allow:

- Power nonlinear loads at the same time very low voltage distortion.
- Providing high-quality output voltage in the event of sudden changes in load (impact load)
- Increase reliability by simplifying the circuit,
- Reduction in operating costs due to high efficiency.
- Microprocessor control display with keypad offers the following options:
  - Fast browsing UPS operation modes on the display panel.
  - Display load rating by bar graph
  - A wide range of operating systems remotely.
  - Parallel configuration enables to increase the power output to the load, introduce redundancy and increase the MTBF (mean time between failures). [4]

## **5 CONCLUSION**

The main aim of the thesis was to characterize the energy security of airports for air traffic regularity and safety of airport operations. At the beginning of my work describes requirements for energy security, different sources of electricity that are part of maintaining a high level of aviation safety.

The work is devoted to the further division of the UPS and monitoring them. Uninterruptible Power Supplies are designed to ensure a constant supply voltage for important facilities such as airports, computer systems, technological process control systems etc.

The main tasks of backup resources are to ensure the power supply in case of power supply network. In order to allow fast and accurate analysis of the situation it is necessary to monitor back up power. Accordingly, it is possible to create a hierarchical view of the almost unlimited.

## 6. LITERATURE LIST

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