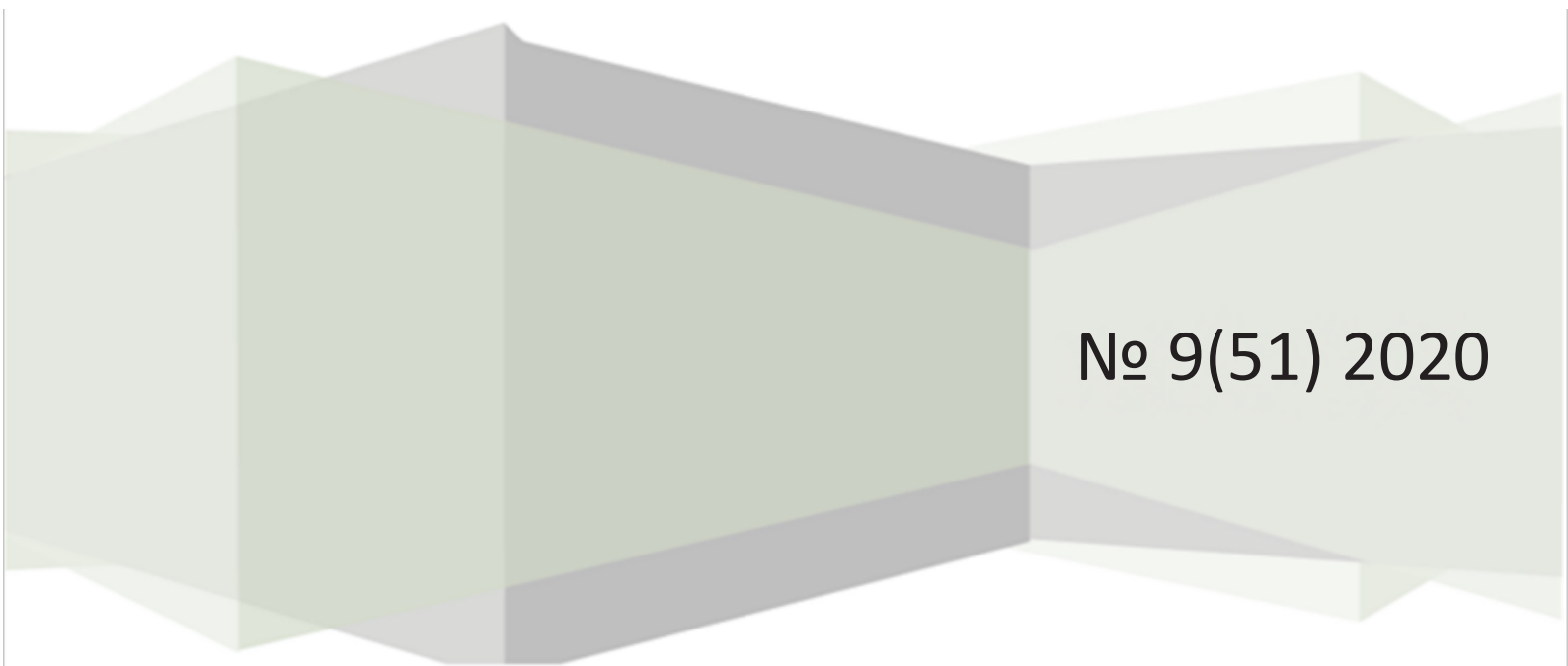


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Assessment of the Efficiency of Power Distribution Systems (Onboard Cable Network) of Modern Aircraft during Operational Maintenance

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Key words and phrases: power supply; aircraft; network; evaluation; maintenance.

Abstract. The purpose of the study is to characterize the power distribution systems on the ship. The research objectives are forms and methods for evaluating the efficiency of power distribution systems. The research hypothesis is determined by the fact that the article considers the features of evaluating the efficiency of power distribution systems of modern aircraft during operational maintenance. The paper uses general scientific research methods. The results of the study are that special attention is paid to the calculation of the main indicators that characterize the power supply chain of the onboard cable network. The possibilities and prospects of using intelligent systems for diagnostics and monitoring the state of the on-Board cable network are also considered.

The aircraft's power supply system consists of DC and AC power generation systems. Common sources of electricity on an airplane are:

- two DC generators with a specific power, rated voltage and rated current;
- two alternators with a specific power, rated voltage, frequency 400–900 Hz and rated current. Secondary sources single-phase alternating voltage of 115 V 400 Hz AC three-phase voltage 36 V 400 Hz can be two combined Converter with a nominal capacity of respective channels 115 and 36 In [5].

Generators and converters in flight provide power to each group of electricity consumers, while they are connected, which allows them to work in parallel. All consumers of direct and alternating current electricity, depending on the degree of significance, are connected to the common or emergency bus of the distribution equipment. Emergency DC power supply is provided by two 24 V batteries with a capacity of 25 Ah each. This is also reflected in the environmental components [7]. There is no doubt that to assess the efficiency of the power distribution system in aircraft, it is necessary to determine whether the AC frequencies fit into the “tolerance tube”, one of the types of which is shown in Fig. 1.

Typical causes of voltage output beyond the limits of the “tolerance tube” in the failure state are the following: failure of the generation channel; short circuits in the distribution channel;

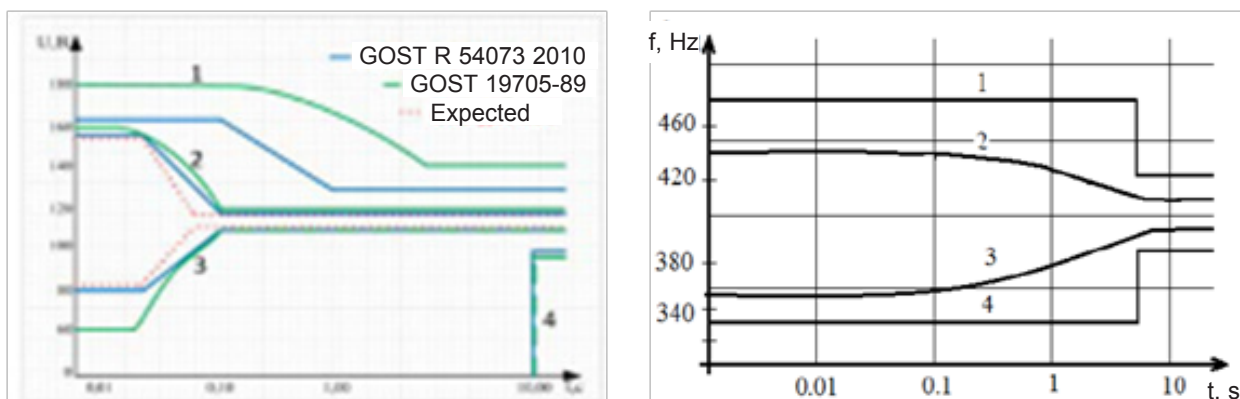


Fig. 1 “Tube tolerance” quality control voltage (a) and frequency (b) in terms of quality of normative-technical documents, as well as the desired requirements for the voltage quality of the distribution system (a)

transients due to incorrect calculation of loads on the distribution channel [6]. In this case, to assess the effectiveness, it seems appropriate to calculate the main indicators that characterize the power supply circuit of the onboard cable network: the value of the voltage drop ΔU , V; value of the wire cross-section plane S_p , mm^2 , the balance of the voltages of the transformer [4]. The value of the voltage drop is determined by the formula:

$$\Delta U = \frac{\rho l I}{S},$$

where ρ is resistivity of the wire material; l is wire length; I is current consumption; S is wire cross-section plane.

The cross-sectional area of the wire is calculated as follows:

$$S_p = \frac{\rho l I}{\Delta U_z},$$

where ΔU_z is permissible voltage drop of the circuit section ($\Delta U_z = U_{max} - U_{nominal}$).

The condition must be met: $S_p < S$. The balance of the voltage transformer:

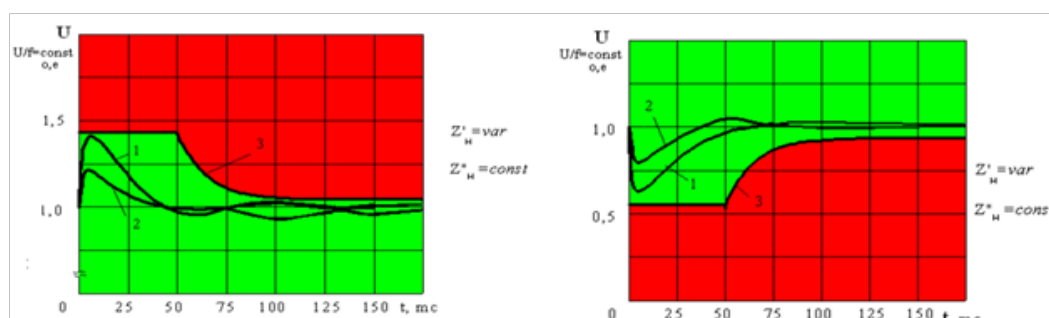
$$\begin{cases} U_o \sin(\omega t + \varphi) = L_s i'_s + i_s r_s - M_0 i'_{tr} \\ M_0 i'_s = L_r i'_{tr} + i_{tr} r_r \end{cases},$$

where $i_s, i'_s, i_{tr}, i'_{tr}$ are values of primary and secondary windings currents and their derivatives; r_s is active resistance of the primary winding (stator); r_r is active resistance of the secondary winding (rotor); ω is angular frequency; φ – voltage phase; U_o is power supply voltage amplitude value; L_s, L_r, M_0 are the inductance of the primary, secondary, and mutual inductance of the transformer windings, respectively [8].

The direct solution of this equation makes it possible to take into account not only the scattering inductance, but also to determine the effect on the transients of the actual inductance of the primary and secondary windings [5]. Today, in the era of digitalization and intensive development of ICT, intelligent multi-level systems for monitoring the condition and diagnostics of electric power facilities, the main principles of which are:

Table 1. Comparative characteristics of traditional methods for evaluating aircraft cable networks and intelligent diagnostic systems

Traditional approaches	Intelligent systems
Functional diagnostics (constantly or periodically) only for particularly important objects, test diagnostics (during routine inspections)	Diagnostics and remote status monitoring for a wide range of equipment
System of scheduled preventive repairs	Maintenance and repair according to actual condition
Local diagnostics, protection and automation systems for critical objects	Adaptive distributed reliability systems (diagnostics, condition monitoring, self-recovery)


Fig. 2. Transients in SG channels under different operating modes:

a) the results of calculating the transient process by output voltage levels at a constant component of the network load $U/f = \text{const}$ and an increase from 50 to 150 % of the network load $U/f = \text{const}$, $f = \text{var}$; b) the dependence of the transient process when the network load changes $U/f = \text{const}$, $f = \text{var}$ from 150 to 50 % of the rated load and 50 % of the network load $U/f = \text{const}$

- decentralizing computing resources to ensure the necessary frequency of measurement and processing of diagnostic signals received on specific devices;
- combining diagnostic information in a hierarchical manner;
- classification of diagnostic information by degree of criticality to optimize information flows between hierarchical levels of the system.

Table 1 shows the main differences between the traditional approach to on-Board cable network assessment and intelligent diagnostic systems.

An example of an intelligent system for evaluating the effectiveness of an on – Board cable network in aircraft is the Aircraft Diagnostic and Maintenance System – ADMS, which is a centralized tool for performing most maintenance and diagnostics operations on modern aircraft. This system allows you to register events and failures of aircraft electrical systems, which makes it possible to get information and respond to it to engineering personnel in a short time with the possibility of remote data processing in the event of a system failure on Board a modern aircraft.

For example, in order to analyze the quality of electrical energy in the channels of a synchronous generator (SG), the ADMS system allows you to build oscillograms that reflect transients at a load value of 50 % of the rated power, and when the load changes abruptly from 50 % to 150 % of the rated power (Fig. 2).

Thus, summing up the results of the study, we can draw the following conclusions. Today,

there are various methods and techniques for evaluating the effectiveness and technical diagnostics, monitoring and monitoring the state of power distribution systems of modern aircraft during operational maintenance. They allow you to calculate the balance of power and loads of power sources, determine how much the required power reserve of on-Board DC and AC sources is provided, and so on.

At the same time, there are significant prospects for intelligent analysis systems, the active implementation and use of which will improve the reliability and manageability of all elements of the aircraft's electrical network, as well as ensure timely detection of malfunctions and prompt response of the engineering team.

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**Оценка эффективности систем распределения электроэнергии
(бортовой кабельной сети) современных воздушных судов
при оперативном обслуживании**

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г. Самара (Россия)*

Ключевые слова и фразы: обслуживание; оценка; самолет; сеть; электропитание.

Аннотация. В статье рассматриваются особенности оценки эффективности систем распределения электроэнергии современных воздушных судов при оперативном обслуживании. Целью исследования является характеристика систем распределения энергии на судне. Задачами исследования выступают формы и методы оценки эффективности систем распределения электроэнергии. В работе использованы общенаучные методы исследования. Отдельное внимание уделено расчету основных показателей, характеризующих цепи питания бортовой кабельной сети. Также рассмотрены возможности и перспективы использования интеллектуальных систем для диагностики и мониторинга состояния бортовой кабельной сети.

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Diagnostic System to Monitor the Transformer with the Automated Control System

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Key words and phrases: monitoring; thermal conductivity; thermocouple; transformer; sulfur hexafluoride.

Abstract. In the article, the authors consider the installation for cooling the transformer. The aim of the study is to improve the cooling efficiency of an oil transformer. A diagnostic system has been developed to measure the thermal conductivity of transformer oil and monitor and maintain the temperature, which protects the transformer from overheating, preventing a sudden stop of electrical equipment and increasing its service life.

Introduction

The current state of the energy sector is characterized by a constant increase in power consumption. A large industrial enterprise is usually a complex technical system of hazardous production facilities, the technical condition of which affects the continuity and safety of technological processes.

Transformers are an integral part of the fuel and energy complex and housing and utilities because energy is distributed from sources to consumers through it, so the emergency shutdown of the transformer is extremely undesirable. In order to prevent this, constant and high-quality control over the state of the transformer is necessary.

During the operation of the transformer, the oil is heated unevenly: the upper layers have a higher temperature than the lower ones. To increase the cooling efficiency of the oil transformer, it is necessary not only to provide for oil circulation, but also to select a thermal conductivity coefficient that provides high heat exchange with the environment.

This paper describes an automated system that allows you to measure the thermal conductivity of transformer oil, as well as maintain the temperature in a given range. A complex for cooling an oil transformer using oil bubbling with sulfur hexafluoride is proposed. Sulfur hexafluoride has a high coefficient of thermal expansion, which easily forms a convective flow that redistributes heat flows. The use of specially developed programs for measuring the non-stationary temperature field in the presence of pop-up gas bubbles and their absence makes it possible to determine the effective coefficient [1–2].

Description of the installation

In [3–7], an installation for cooling transformer oil using gas is presented.

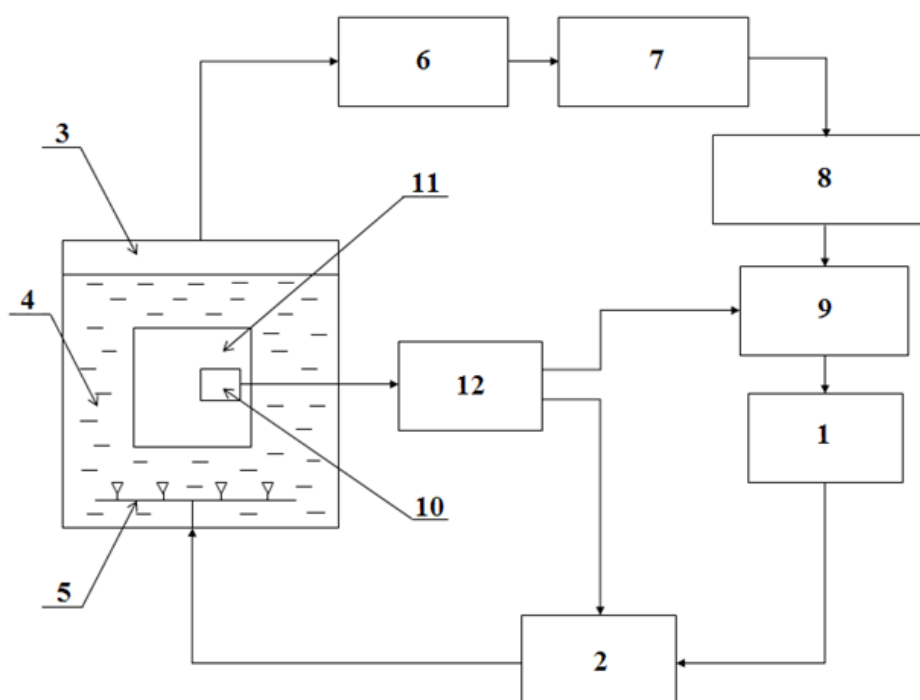


Fig. 1. Block diagram of the installation

The block diagram is shown in Fig. 1.

We look at how the installation works. From the tank 1, the sulfur hexafluoride compressor 2 is fed to the tank 3 by valves-distributors 5. Transformer oil 4 with the sulfur hexafluoride circulating in it carries out heat removal from the transformer windings. Gas bubbles, floating in the transformer oil, carry away oil particles, which are sequentially separated from the gas in the expander tank 6, in the fine filter 7 and in the coarse filter 8, the remaining oil is absorbed by absorbers. Then the gas is cooled in the refrigerator 9 and gets back into the container with the gas. Directly in the area of the transformer winding 11, a temperature sensor 10 is installed, the output of which is connected to the input of the control unit 12. When the transformer windings are heated above the set value, the control unit sends on signals to the control inputs of the compressor and refrigerator. When the temperature of the transformer windings decreases below the set value, the control unit sends off signals to the control inputs of the compressor and refrigerator.

Module for measurement of thermal conductivity consists of thermocouple, the signals from which are input to the analog – to digital Converter ADAM 4018. In (the manufacturer Advantech), signals from which are received at the operator station (computer) where the software is installed for recording the output of the experiment to determine coefficient of thermal conductivity of transformer oil with pop-up gas bubbles GetEditText.exe.

The process of maintaining the temperature in manual mode is inconvenient, since it requires the operator to constantly monitor the operating mode, while automatic mode allows continuous monitoring of the transformer condition [7].

A program is used to record the results of experimental measurements and control the temperature of transformer oil using pop-up gas bubbles.

The program provides the following functions:

- creating files (“log1.txt”, “log2.txt”, “log3.txt”, “log4.txt”);

– record the temperature value, at the moment, respectively, from the first, second, third and fourth thermocouple in the format “hours: minutes: seconds”.

Results and discussion

The transformer oil temperature is controlled as follows: when the set upper temperature limit is reached, the compressor is turned on and the cooling gas enters the tank, and when the lower temperature limit is reached, the compressor is turned off.

This program is used to record the values of temperature changes from time to time in order to further determine the coefficients of thermal conductivity and heat transfer of transformer oil with floating gas bubbles.

Thus, the use of bubbling makes it possible to regulate the thermal conductivity of a power oil-filled transformer, which is important for extending the transformer's performance. The developed diagnostic system allows measuring the thermal conductivity of transformer oil and monitoring and maintaining the temperature, which protects the transformer from overheating, preventing sudden shutdown of electrical equipment and increasing its service life [7; 8].

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**Диагностический комплекс для контроля трансформатора
на основе автоматизированной системы управления**

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Ключевые слова и фразы: барботирование; контроль; теплопроводность; термопара; трансформатор; элегаз.

Аннотация. В статье авторами рассмотрена установка для охлаждения трансформатора. Целью исследования является повышение эффективности охлаждения масляного трансформатора. Разработан диагностический комплекс, позволяющий измерять теплопроводность трансформаторного масла и осуществлять контроль и поддержание температуры, что защищает трансформатор от перегрева, предупреждая внезапную остановку электрооборудования и увеличивая срок службы.

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Ensuring Safe Operation of Buildings and Structures

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Key words and phrases: building; structure; operation; safety.

Abstract. The purpose of the article is to study issues related to ensuring the safe operation of buildings and structures. To achieve this goal, the following tasks were solved: to study the available material on this topic; to consider the main requirements for ensuring the safety of buildings and structures during operation; to list the main principles for ensuring the safe operation of buildings and structures. The novelty of the work is to systematize data on ensuring the safe operation of military buildings and structures. To solve these problems, the article uses such methods as analysis, synthesis, description, and generalization. The result of the study is as follows: it was shown that currently military buildings and structures fully meet the safety requirements for their operation.

The level of civilization at the present stage includes a high anthropogenic impact on the human environment. This requires the creation of safe living conditions for the person who is in it.

Currently, one of the most important roles for a person is played by modern structures. We can say with confidence that the achieved level of development of society, as well as culture, education, etc., very much depends on how high-quality structures are used in people's activities.

Ensuring operational safety of military buildings and structures should be created by:

- maintenance;
- regular inspections;
- control checks and continuous inspection of the base, the structure itself and all engineering systems;
- carrying out current repairs.

All operational parameters that were laid down in the construction documentation at the construction stage must fully coincide with them. To ensure the efficient operation of buildings and structures, it is necessary that the constructed buildings meet the energy requirements and are fully equipped with all necessary accounting tools throughout the entire life of the building [1].

Maintenance and current repairs are carried out in order to ensure the necessary level of

technical condition of the operated structures. The proper condition is to maintain values of stability, reliability, design structures, and, in addition, the health structures of buildings and constructions, engineering networks and systems, elements, engineering systems and networks within the framework of requirements that describe the required technical regulations, as well as the original documentation [2].

In accordance with all operational requirements, newly constructed and created buildings are supposed to:

- have high reliability, which means correctly performing all the functions defined for them in specific operating conditions in a given time period, taking into account the safety of their basic parameters within the specified limits;

- be the simplest and most secure in their operation, which can be achieved by creating a rational plan of premises, stairs, ventilation shafts, means used to extinguish fires, while in order to carry out repairs of large-sized elements in structures, special hatches, openings, etc. must be available;

- be simple and effective in maintenance and current repairs means they have the ability to conduct these operations on every possible sites, have a comfortable stair approaches and, in general, have the least costs, which will not require the removal procedure to gain access to the necessary areas, as well as modern devices and mechanisms that can apply for work in tight areas, including various fasteners, power supplies, etc.;

- be repaired, which should mean that the construction of buildings should be adapted to carry out any maintenance work without harming neighboring elements and at the same time spending the minimum possible resources;

- have the maximum possible and equivalent inter-repair service life for each structure;

- have high efficiency during the entire operation process, which is ensured by the use of structural materials that have a sufficiently high service life, while there should be minimal possible costs for heating, ventilation, power supply, etc.;

- have an external architecture that would correspond to the purpose of the building, its place in the built-up area, and, in addition, that it has a pleasant view for viewing, and the internal architecture of the structure should not lead to overwork of people, have the lowest possible degree of contamination and ease of cleaning and restoration [5].

Depending on the purpose for which the structure is designed and constructed, all the necessary parameters are taken into account in its initial design. As already noted, after the construction of the building and its commissioning, these values should lie in the normal deviation for the entire life of the building. In the rules [3] lists the specific requirements that are introduced by the establishment of any military facilities [6]. Multifunctional buildings that include several groups of structures that completely differ in their purpose requirements are developed in accordance with the requirements listed in specific points of this standard. When creating it, keep in mind that a number of rooms can be used for various purposes. Houses and dormitories where workers and officers will live, hotel facilities, warehouses, food and household stores, shopping complexes, boiler houses, fire stations and other structures should be developed taking into account official, current regulations and laws of the Russian Federation using modernized versions that are used in various departments of the Russian Federation, taking into account all the requirements of local construction. Barracks for conscripted soldiers, as well as dormitories for cadets and soldiers who serve in the army under contract and do not have a family, must be located inside the military camp and must be designed and built in accordance with the requirements of specific points of this standard [7].

In order to protect buildings and structures located in the Ministry of defense of the Russian

Federation from the effects of lightning strikes, a whole range of measures is applied, including:

- external lightning protection system, which includes lightning receivers, a device for removing electric current and grounding devices;
- internal lightning protection system, which includes devices used to protect inputs, grounding lines, devices for potential equalization, as well as shielding elements.

The norms [5] list all the most important values of lightning discharges, provide the most complete set of measures to create and ensure the protection of objects from direct lightning hits, as well as ways to determine the maximum external lightning protection system.

Safe operation of buildings should be achieved by setting the necessary parameter values, as well as their further implementation in the time interval during which the building is erected and their further maintenance at the specified level during the operation of the building.

The values of these parameters, as well as all other necessary characteristics, must be specified in the design documentation for the structure so that it includes the necessary level of probability of ensuring a safe standard of living for people, as well as preserving their property both during the entire construction stage and during the operation of the erected building. To do this, these values must be justified by the following results:

- calculations that were made according to already approved and proven methods;
- testing of real models or structural elements of the building;
- modeling of possible hazards.

The initial values required for calculations and tests should consist of statistically valid values of the climatic influence on the built – up area, parameters of the frequency and intensity of occurrence of dangerous natural and human impacts, the results of various engineering surveys on the construction site, and in some cases-in the zone of a certain land plot [1].

To create conditions for the safe operation of constructed buildings, it is necessary to take into account all the necessary issues and solve them at all stages, starting with the development of the building structure and ending with the expiration date.

The main activities that are carried out to ensure the safe operation of structures include the following:

- periodic checks;
- constant filling in of technical data sheets;
- instrumental measurement of stresses in structures of buildings;
- meeting the requirements for the values of permissible loads that can be applied to the load-bearing parts of the structure.

Operation of water use facilities is associated with a large number of harmful and dangerous factors. A certain part of them can be excluded at the design stage, using a competent layout of equipment, using collective means of protecting service personnel. When operating structures, the most important condition for trouble-free operation, ensuring the efficiency and health of service personnel is their professional training, clear knowledge of safety regulations.

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Обеспечение безопасной эксплуатации зданий и сооружений

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Ключевые слова и фразы: безопасность; здание; сооружение; эксплуатация.

Аннотация. Цель статьи – изучить вопросы, касающиеся обеспечения безопасной эксплуатации зданий и сооружений. Для достижения поставленной цели были решены следующие задачи: рассмотрен имеющийся материал по данной тематике; изучены основные требования к обеспечению безопасности зданий и сооружений в процессе эксплуатации; перечислены основные принципы обеспечения безопасной эксплуатации зданий и сооружений. Новизна работы заключается в систематизации данных об обеспечении безопасной эксплуатации военных зданий и сооружений. Для решения поставленных задач в статье использованы такие методы, как анализ, синтез, описание, обобщение. Результат исследования следующий: было показано, что в настоящее время военные здания и сооружения полностью соответствуют требованиям безопасности при их эксплуатации.

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Economic Aspects of Enhancing Physical Culture and Sport in the Region (The Example of the Smolensk Region)

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Key words and phrases: economy of physical culture and sports; sports sponsorship.

Abstract. The study aims to identify potential sponsors and their interest in funding Smolensk sports organizations. The objective is to conduct a survey of managers of various commercial enterprises in Smolensk and the Smolensk region. It was assumed that this study will provide a deeper understanding of the problems and prospects of economic development of physical culture and sports in the Smolensk region. The main method was a survey and questionnaire. This article presents the results of the study conducted in the period from 2014 to 2020.

Introduction

The problem of developing sports as a commercial industry in the Smolensk region, as in most representatives of the Russian hinterland, is extremely acute, and is mainly directly dependent on the ability of sports organizations to attract non-governmental, sponsorship funds [1]. The problem of finding sponsors for sports organizations is becoming particularly acute and urgent in the context of the permanent economic crisis in our country, which has been getting worse since the beginning of 2020.

Methods

In order to determine the level of investment interest in Smolensk sports organizations from potential sponsors, we conducted a survey in the form of a questionnaire in November 2019 – March 2020. All available modern means of communication were used for conducting the survey: telephone communication, business websites on the Internet, social networks, Viber and WhatsApp messengers. In total, 22 managers of various commercial enterprises in Smolensk and the Smolensk region took part in the survey. The main criterion for selecting survey participants was the infrequent mention in the media of their participation in the sports life of the region, hometown or district.

Results and discussion

The majority (73 %) of representatives of the business community surveyed are sure that

it is necessary to provide material and financial support to sports organizations in their city or district, while the rest found it difficult to give a clear answer. The same number – 73 % of respondents – believe that sponsorship in principle is not able to solve the problem of underfunding physical culture and sports in our region, apparently completely rejecting the idea of shouldering responsibility for the material and financial support of physical culture and sports organizations, and only 36 % of respondents are sure that this is possible.

At the same time, it is very optimistic that almost all enterprises that participated in the survey, in one way or another, but supported or support the physical culture and sports organizations of the region.

Most often the focus is on one-time, insignificant assistance to sports organizations, namely, financial assistance in conducting certain sports events, mainly competitions, allocation of funds for the purchase of awards and prizes to their winners, as well as awarding their own prizes and awards. Unfortunately, among the twenty-two companies participating in the survey, there was not a single one that was a permanent sponsor for any of the local physical culture and sports organizations, and fully covered the costs of organizing and conducting competitions, the training process, athletes' trips to training camps and higher-level competitions, the purchase of sports equipment, uniforms, award products, etc.

The main returns for the sponsor come from advertising their products or their company. Hence, the general rule is that the amount of sponsorship directly depends on the advertising capabilities of sports organizations. The potential sponsors of Smolensk sports clubs and other sports organizations interviewed in the survey are encouraged to participate in the life of sports organizations in the Smolensk region.

The main reasons for their sponsorship and the findings of the survey are as follows:

- presentation and promotion of the company (brand): 82 %. Note that, 27 % of respondents are not interested in sponsorship at all;
- the interest of the company's top management personnel in a particular sport (the Managing Director or CEO does a particular sport): 54 %;
- disinterested assistance: 27 %;
- noble action: 82 %.

According to the results of the survey, the factors that have a deterrent effect on sponsorship include:

- lack of tangible tax benefits, subsidies, and other tools of state support for private investors that encourage the use and implementation of sponsorship projects in sports: 80 %;
- high investment risks and low financial/advertising returns from sponsorship investments ("the invested funds do not pay off, as the advertising opportunities of local sports organizations are very low"): 70 %;
- the limited number of big companies (firms, enterprises, etc.) that can invest in sports in the Smolensk region: 40 %;
- administrative barriers (red tape, multiple approvals, difficulty in obtaining benefits for sponsorship activities, etc.): 30 %;
- unfavorable tax conditions: 30 %;
- instability of the economic situation in the country (rising prices for energy, utility services, raw materials and other economic resources, additional taxes and duties, etc., leading to financial losses of the enterprises): 20 %.

The analysis of banner advertising related to the promotion of physical culture and sports, the creation of a positive image of enterprises on sports facilities and main streets of the regional center showed that local sports organizations, sponsors, advertisers, and advertising agencies

have a rather weak understanding of the specifics and features of sports advertising activities. This applies both to the ad text itself and to its design. About 76 % of respondents consider the use of billboard and banner ads to be one-time, costly and ineffective. This leads to the fact that this type of advertising is either not used at all, or very rarely.

Conclusion

Currently, none of the physical culture and sports organizations we have studied has a permanent sponsor. Note that in 2014, there were 20 % of such sports organizations in the region.

It also turned out that the advertising fund of most Smolensk sports organizations and clubs does not exist at all, as well as the structural division responsible for finding and working with potential sponsors. In the same organizations where it is available, the advertising Fund does not exceed 1 % of the total budget expenditures. All this leads to the fact that potential sponsors-advertisers try to refrain from financing mass physical culture and sports, preferring to invest in other areas that are more effective in terms of advertising and financial returns, and assistance to sports organizations is limited only to allocating small funds to buy awards, prizes to winners, as well as awarding their own prizes and awards.

The main motive that encourages sponsors to participate in the life of physical culture and sports organizations in the Smolensk region is to promote their brand and create a positive image of their company. Another reason is an interest of the leader of the sponsor organization in a particular sport. Finally, sponsorship is often seen as a charitable one-time noble action.

The majority of representatives of the business community of the region surveyed – 73 % – are convinced that it is necessary to provide material and financial support to physical culture and sports organizations of their city or district, but the same number of respondents are sure that sponsorship is not able to solve the problem of underfunding physical culture and sports.

It should be noted that almost all the enterprises that participated in the survey, in one way or another, if possible, supported or support sports organizations in our region.

In total, as of 2018, there are 2,417 sports facilities in the Smolensk region, including 25 stadiums, 4 indoor sports arenas with artificial ice, 598 standard sports halls, two 25-meter swimming pools and one 50-meter, 19 ski bases, 1,209 flat sports facilities. There are 42 children's sports schools, including 11 sports schools, with a total number of more than 20 thousand people involved, and about 70 sports clubs.

Unfortunately, in recent years, many famous professional Smolensk sports clubs have ceased to exist, teams and players have been disbanded. For example, the following were closed: SGAFKST-Phoenix volleyball club in 2016; Avtodor Mini football club; Slavutich hockey club, founded in 2010. The Smolensk Association of diamond producers, VASH Dom CJSC, the Smolensk state Academy of physical culture, sports and tourism, the Smolensk region hockey Federation, stopped competitive activities in 2017, and a number of others. This is due to many reasons, the main of which is the permanent economic crisis in the country, due to which large enterprises and retail chains are closed or reorganized, as a result of which sports clubs lose their existing and potential sponsors.

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**Экономические аспекты развития физической культуры и спорта в регионе
(на примере Смоленской области)**

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Ключевые слова и фразы: спортивное спонсорство; экономика физической культуры и спорта.

Аннотация. Цель статьи – определение уровня инвестиционного интереса к смоленским физкультурно-спортивным организациям со стороны потенциальных спонсоров. Задача – провести опрос руководителей различных коммерческих предприятий г. Смоленска и Смоленской области. Предполагалось, что данное исследование даст более глубокое понимание проблем и перспектив экономического развития сферы физической культуры и спорта в смоленском регионе. Основными методами являлись опрос и анкетирование. В данной статье представлены результаты проведенного исследования в период с 2014 по 2020 гг.

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Development of International Hotel Chains in Singapore and Vietnam

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Key words and phrases: ASEAN; destination; hotel business; international hotel chain; international tourism; Singapore; UNESCO world heritage sites; Vietnam.

Abstract. The purpose of the research is to identify the main trends and prospects for the development of international hotel chains in the tourism market of the ASEAN countries (both in the whole region and on the example of Singapore and Vietnam). In accordance with this goal, the tasks were solved: to identify the level of development of international hotel chains in the region, to characterize the regional specifics of the development of the hotel industry in Singapore, to analyze the regional specifics of the development of the hotel industry in Vietnam. The research hypothesis is that the hotel industry is an industry that contributes significantly to the GDP of the ASEAN countries, serves as an alternative for the development of the region and solves the problems of employment. To achieve this goal, the following research methods were used: statistical analysis, comparative analysis, and ranking. The article analyzes the level of development of international hotel chains in Singapore and Vietnam based on official statistics. A comparison between the most economically developed country in the region and the economically lagging country is made. Various factors affecting the hospitality industry, namely, the level of economic development of countries, tourism attractiveness of destinations, and tourism competitiveness are considered. The authors' typology of the countries under consideration according to the density distribution of the rooms and saturation of the market of hotel services is proposed.

Southeast Asia is one of the world's most popular destinations. The countries of the region form an international organization called ASEAN. In recent years, the association of these states has achieved significant success in the development of tourism. More and more people from the European Union and the United States prefer to travel to exotic countries, where the quality of services is improving. The tourism services sector of the ASEAN countries makes a

very high contribution to the economy (from 20 % and more) for Cambodia, the Philippines and Thailand, while for Singapore, Vietnam, Indonesia and Malaysia, this figure varies from 10 to 19 % [3]. The presence of a developed hotel industry and especially international hotel chains is important for the dynamic development of tourism in this group of countries.

Various hotels are located in all countries of the world, and their number depends on the popularity of the destination. The active growth of international hotel chains plays a key role in the development of the modern hotel business. It is a trademarked hotel group operating in two or more countries and maintaining the same quality and service standards [1].

The article analyzes the level of development of international hotel chains in Singapore and Vietnam on the basis of official statistics. The most economically developed country in the region, Singapore, and the economically lagging country, Vietnam, are compared. Both states are located in the Eastern Hemisphere in the extreme southeast of the Eurasian continent. The geographical position is favorable. Singapore is a city-state located on the island of Singapore and islands off the Malacca Peninsula, with a total area of 692.7 km². Vietnam is located in the eastern part of the Indochina Peninsula and is completely washed by the South China Sea, with an area of 331,210 km² [9]. The variety of natural conditions that attracts many tourists to the country is due to its location at the border of various natural zones, which cannot be said about Singapore.

It is important to note the total number of UNESCO World Heritage Sites for which millions of people come to the region every year. In general, Vietnam has 8 UNESCO World Heritage Sites (5 cultural, 2 natural, 1 mixed). There is only one UNESCO site in Singapore – the botanical garden, which is classified as a cultural site [7].

The countries under consideration also differ greatly in terms of their level of economic development. The difference is that Singapore is a post-industrial state, where the leading sectors of the economy are the service sector (75 %): finance, science, tourism; industry (25 %): electronics, informatics, biotechnology. Vietnam remains an agro-industrial country. The leading role in the economy is played by agriculture (16 %), industry (32 %), the service sector lags far behind. Indicators reflecting the level of economic development of countries, namely, the indicator of GDP per capita, differ greatly. Vietnam has \$ 2,546 for 2018, and Singapore has \$ 64,567 [9].

The countries in question are quite popular destinations and need a large number of places to accommodate people. The flow of foreign tourists to Singapore is formed by intraregional travel, primarily from countries such as China, Malaysia, Indonesia, and Australia. The total number of arrivals to the country is 18.5 million [4]. The country is actively promoting itself in the world tourism market as a “gateway” to Southeast Asia [2]. International tourist arrivals in 2018 in Vietnam amounted to 15 million people, leading in terms of the number of arrivals are international tourists from China (4.9 million people), the Republic of Korea (3 million people) [6]. Tourists go for an inexpensive beach vacation.

One of the leading hotel markets in the Asia-Pacific region (**APR**) is concentrated in the “gateway” of Southeast Asia (Singapore). It is dominated by chain hotels, accounting for 83 % of the total number of registered rooms. Of the 90 brands currently on the Singaporean market, over 72 % are international chains. Among them is the Accor hotel chain, which offers the highest number of rooms, namely 5,992 in 15 hotels [5]. Below is a comparative table – 10 leaders of international hotel chains in Singapore by the number of hotels and rooms (Table 1).

As a mature market, the average occupancy rate of hotel chains in Singapore has been consistently high over the past seven years, hovering between 83 % and 84 %. Meanwhile,

Table 1. The largest international hotel chains in Singapore for 2018.
Compiled from source [5]

Rank	International hotel chain	Number of hotels	Number of rooms
1	Accor	15	5,992
2	Mariott International	13	4,058
3	IHG	8	3,047
4	PPHG	8	2,637
5	Millennium & Copthorne Int.	6	2,608
6	Las Vegas Sands Corporation	1	2,560
7	Shangri-La Hotels&Resorts	5	2,392
8	Resorts World	7	2,168
9	Park Hotel Group	6	2,039
10	Hilton	3	1,256
Total	10	72	28,757

Table 2. The largest international hotel chains in Vietnam for 2018. Compiled from source [5]

Rank	International hotel chain	Number of hotels	Number of rooms
1	Accor	32	7,481
2	IHG	9	2,782
3	Mariott International	7	2,437
4	Ascott	7	1,050
5	Media Hotels International	4	802
6	Hyatt	2	620
7	Lotte Hotels	2	601
8	Okura Nikko Hotels	2	591
9	Rosewood Hotels	1	533
10	PPHG	2	459
Total	10	68	17,356

the country's RevPAR (Revenue per Available Number) has been increasing for two years from 2013 before entering a three-year decline. For 2017, that's S \$ 182. As of December 2017, a total of 420 hotels with 67,085 rooms were recorded in Singapore [5].

When it comes to Vietnam, it is important to note its success story. Reforms launched in 1986 have transformed the domestic market-oriented country into one of the fastest growing

Table 3. Saturation of the hotel services market and the density of distribution of rooms in Singapore and Vietnam. Compiled from source [2]

Country	Number of hotels	Number of rooms	Saturation of the hotel services market	Density of distribution of rooms	Rank
Singapore	420	67085	1195	10360	1
Vietnam	356	50687	54	15	2

economies in Southeast Asia. The hotel market in Vietnam is currently under development and consists mainly of independent or family-owned hotels. For 2017, the country has 356 hotels with 50,686 rooms. Only 1 % of all hotels and 12.1 % of the number of rooms belong to international hotel chains [5]. However, the number of international hotels has increased significantly in recent years, and many more are planned for the coming years. The largest hotel chains, as well as their indicators available in Vietnam, are presented in Table 2.

The leader in the number of hotels and rooms in both countries is the Accor hotel chain. This is primarily due to the large geographical representation of the company. Accor operates in 111 countries around the world, which gives it additional revenue opportunities [8]. This hotel chain uses a multi-segment approach in forming its portfolio (the client can switch from using an expensive brand of the chain (Sofitel, Pullman) to a cheaper one (Ibis, All seasons) [1].

One of the most important indicators that determine the level of hotel infrastructure development is the saturation of the hotel services market. It is calculated as the ratio of the number of rooms to the population of the country. Thus, the percentage of hotel rooms for this indicator was obtained, and a typology was drawn up. The result of the calculation is reflected in Table 3. The countries with a low rate (less than 100 %) include Vietnam, since the number of rooms in the state is small in comparison with the population. Singapore has a high indicator (over 100 %), which is due to its lower population.

Another important indicator is the distribution density of numbers, which is calculated as the ratio of the number of numbers to the size of the country's territory. Thus, the percentage of hotel rooms for this indicator was obtained, and a typology was drawn up. The result of the calculation is shown in Table 3. Vietnam has a low indicator (less than 100 %), since the number of hotels in comparison with the size of the territory is small. Singapore belongs to the countries with a high rate (more than 100 %), because it has a fairly large number of hotel rooms and a small territory.

Thus, the countries of Southeast Asia are rapidly developing, occupying every year more and more positions in the world tourism market. Trends and prospects for the development of international hotel chains are high, which is facilitated by many factors. These are price competitiveness, investment attractiveness, favorable geographical location of destinations and their saturation with various natural and cultural sites, specialization of countries in the tourism sector, etc. [3].

Vietnam is at this stage a developing country with a high growth in international tourist arrivals. Most of the hotels in Vietnam are private. But due to the low level of economic development in the country, it is rather difficult to develop international hotel chains. Basically, their implementation takes place through investments. The hospitality industry consists of independent or family-owned hotels, with international hotel chains accounting for just over 1 % [5]. Despite this, the trends are expected to be high, as the country increases the level of

economic development every year, and also pays more attention to the tourism sector.

In the case of Singapore, the stable dynamics of international arrivals allows the country to improve the quality of tourism services and constantly improve the infrastructure to meet the needs of travelers. The country is dominated by chain hotels (83 %), the average hotel occupancy is over 80 % [5]. Due to the high level of economic development, the cost of accommodation in Singapore is significantly high compared to the rest of ASEAN countries, but at the same time balances the price-quality ratio. About 65 % of tourists arriving in the state stay in hotels. The country's active tourism policy: the transformation of Singapore into a center for business tourism and recreation (construction of the Marina Bay entertainment district, the development of Sentosa Island, and the organization of excursion trips to neighboring countries) contribute to an increase in the tourist flow [2]. Therefore, the development of the hotel business in Singapore is necessary not only in order to satisfy the needs of tourists, but also so that the hotel business itself becomes one of the factors that attract tourists to use luxury services. A mature hospitality market has emerged in the country, so the development of international hotel chains is considered the most profitable in Singapore.

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Особенности развития международных гостиничных сетей Сингапура и Вьетнама

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Ключевые слова и фразы: АСЕАН; Вьетнам; гостиничный бизнес; дестинация; международная гостиничная сеть; международный туризм; объекты Всемирного наследия ЮНЕСКО; Сингапур.

Аннотация. Целью исследования является выявление основных тенденций и перспектив развития международных гостиничных сетей на туристском рынке стран АСЕАН (как в целом региона, так и на примере Сингапура и Вьетнама). В соответствии с поставленной целью решались задачи: выявить уровень развития международных гостиничных сетей в регионе, охарактеризовать региональную специфику развития гостиничного хозяйства Сингапура, проанализировать региональную специфику развития гостиничного хозяйства Вьетнама. Гипотеза исследования: гостиничное хозяйство является отраслью, которая вносит значительный вклад в ВВП стран АСЕАН, служит альтернативой для развития региона и решает проблемы занятости населения. Для достижения в полной мере поставленной цели были использованы следующие методы исследования: статистический анализ, сравнительный анализ и ранжирование. В статье на основе данных официальной статистики анализируется уровень развития международных гостиничных сетей в Сингапуре и Вьетнаме, то есть дается сравнение самой экономически развитой страны данного региона и экономически отстающей страны. Рассмотрены различные факторы, влияющие на индустрию гостеприимства, а именно: уровень экономического развития стран, туристская атрактивность дестинаций, туристская конкурентоспособность. Предложена авторская типология рассматриваемых государств по плотности распределения номеров и насыщенности рынка гостиничных услуг.

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