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POWER SUPPLY FOR STATE-OWNED ENTERPRISES

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ABSTRACT

This article presents a comprehensive study of energy supply problems for state-owned enterprises. The categories considered (financial activity, legal interests, energy system) allow to reveal the special importance of state enterprises for the state economy. Identification of energy supply problems of state-owned enterprises will allow to assess the optimal power capacities of the public legal sector. The revealed regularities of the energy potential will allow us to assess the risks when planning and predicting energy efficiency. The dynamics of the increase in the consumption of electricity by state enterprises is traced, at the same time as the search for alternative sources of resource support is on. The developed infrastructure of state-owned enterprises implies the search for technologically justified solutions to obtain energy resources in an innovative way. Recommended approach of energy-saving systems usage will allow the enterprise manages to optimize the costs. State enterprise is a unique organizational and legal form with the participation of public and legal entities that allow the state to participate in economic processes in the most optimal, efficient and effective way and realize the most significant state tasks. Such tasks include: implementation of public interests, provision of society with necessary goods and services, implementation of separately subsidized activities, production of military equipment, cartridges, gunpowder, chemical production, disposal of hazardous waste. These tasks emphasize a special priority for the presence of public-legal entities in this sector of the economy. The legal nature of state enterprises allows for the most effective implementation of this activity.

Keywords: energy supply, power supply contract, state enterprise, financing, interests of state enterprises, energy security, electrical system, electrical installations, electric network

1. INTRODUCTION

Modern Russia is rethinking its legal interests in the field of energy supply, as well. One of the main reasons for addressing this issue is the adoption of a number of regulatory legal acts that regulate the energy sector. This process is significantly influenced by such an objective condition as the development of energy systems.

The subject of this study is the legal regulation of state enterprises energy supply, as well as energy saving systems. The following goals were set in the course of this research: identify the features of power supply to public enterprises, consider alternative ways of lighting the premises, analyze innovative methods and devices of lighting sources.

2. METHODS

In the course of this work, a wide range of methods was used, both general scientific and of a particular scientific nature. General scientific methods of cognition (analysis, synthesis, induction, deduction) allowed to analyze the elements of power systems. Particularly scientific methods (cybernetic, statistical) allowed to reveal the specific features of the best lighting equipment.

3. RESULTS

The power supply of state enterprises is carried out while considering the level of technical equipment (devices of electrical installations, electric networks), since defence and security directly depend on power supply along with the realization of national interests accordingly. Implementation of light and shadow, light and local illumination of interiors takes priority when illuminating the premises of public enterprises. Use of various kinds of laser lighting equipment is also under way. Development of innovative methods of optical location made it possible to use devices with fluorescent lamps of various types, which has a beneficial effect on the illumination of premises and on the reduction of expenses for state enterprises. Solid-state lasers and LEDs will save energy.

State-owned enterprises have high significance in the priority areas of the state economy. It is for state-owned enterprises that the state assigns special tasks for the most optimal realization of the state and society needs as a whole, especially in such areas as defence and security, where commercial interest is still present, but is not a priority. State-owned enterprises are full-fledged participants of the energy space. State-owned enterprises are unique organizational and legal formations. Uniqueness can be explained as follows: despite the fact that they are commercial organizations, whose activities are aimed at making profits, these enterprises are established by public legal entities, implementing public and national interests, especially in such areas as defence and security, namely the manufacture, development, production of certain species products (ammunition, military equipment and weapons, explosive and chemically dangerous products), disposal of hazardous chemical waste; – ensuring the state's food security in the loss-making or unprofitable industries, and separately subsidized activities.It is important to note, that other business entities may not always be present in these areas because of the special importance of the defence and security for the state, or from a commercial point of view other organizational legal forms are not interested in operating in unprofitable and marginally profitable industries. A state-owned enterprise organizes its financial and economic activities based on the need to perform certain activities and provide services in accordance with the approved estimates of revenue and expenses and the enterprise operations plan [9, p. 48]. Manufactured goods and earnings resulting from the use of property in the operational management of the enterprise, as well as property acquired by it from the proceeds of its activities, are the property of a public formation, which had established a state enterprise. In their financial activities, state-owned enterprises should be guided by the fact that none of their actions should lead to the creation of conditions under which their functions established by the owner will become difficult or impossible to exercise.

Nowadays, energy supply has become an integral part of life of a modern society, its normal existence. Proper functioning of such vital facilities as medical and educational institutions, housing and utilities facilities, banks, without which functioning of a modern society is inconceivable, depends on a smooth supply of energy. At the same time, there exists uncertainty in many significant aspects of energy supply, and among those there is a special need to highlight the issues of qualification in contractual relations in the electric power industry, and particularly the relationship between the subscriber and the sub-subscriber. Thus, for example, L. Andreeva points out the misregulation of these relationships, noting that in accordance with Article 545 of the Civil Code of the Russian Federation: "A subscriber can transfer energy received from an energy supply organization through an affiliated network to another person (sub-subscriber) only with the consent of the energy supply organization. Thus, in the Civil Code, transfer of energy from the subscriber to the sub-subscriber is formulated as the right, and not the duty, of the subscriber" [2]. This means: "The latter can refuse to transfer energy, and in practice often does so, arguing that this activity is not one of his core activities and is not a public one by character" [2].

When it comes to ensuring security of state-owned enterprises and the state as a whole, first of all, it is necessary to draw attention to the energy supply system. Safety and efficiency of state-owned enterprises functioning depends on the correct use (executed in accordance with specially approved rules) and application of methods and ways of energy supply, considering the level of technological infrastructure. Receivers of electric power of enterprises obtain power from the power supply system, which is an integral part of the energy system. The receiving point of electricity is an electrical installation, which collects electricity for the elec-

Table 1. Four Categories of Luminescent Lamps

Type	Function
T8 with a bulb 26 mm in diameter	A standard lamp used to illuminate most rooms. Power potential of 18 or 36 watts. Sufficiently sensitive to a decrease in air temperature – when the temperature drops below zero, the lamp's trigger mechanism switches off.
T5 with a diameter of 16 mm	Upgraded model, shorter than a standard bulb by 5 centimetres. In the production of T5, a special kind of phosphors, which ensures a more qualitative glow, is used. This lighting device contains a reduced amount of mercury (up to 3–5 g) and is less dangerous for the environment and humans.
T12 with a diameter of 38 mm	Another standard type used in light fixtures where T8 does not fit. Available with different power and colour temperatures.
CFL	Compact lamps, designed to be connected into small light fixtures. They have a traditional E27 (E14 – reduced size) cap or a special design with four pins for connection. Capacity from 18 to 80 W.

tric receivers of enterprises from an external power source. The level of electric receivers power supply uninterruptedness by electric energy at any time is determined by their operation modes. Power load estimation is the first step in the design of any power supply system. Capital investments in the power supply system, operational costs, and the reliability of the electrical equipment depend on the correct assessment of the power loads. Energy issues have been relevant at all times [3]. Electric power in enterprises is considered as one of the components of the production process, along with raw and required materials [4]. When designing a power supply system or analyzing its operating modes, EE consumers are considered as loads. With regard to electricity supply, a unitary enterprise is deemed ineffective, if 50 % or more of the total number of uninterrupted 24-hour power supply violations were liquidated during the year in breach of the requirements established by the current legislation of the Russian Federation. At the same time, a break in the provision of utility services for power supply is not allowed, if it may lead to the disconnection of networks and equipment that is a part of the common property in the apartment building, including pumping equipment, automatic technological protection devices and other equipment that provides trouble-free operation of in-house engineering systems and safe living conditions for citizens. General requirements that must be observed when designing power supply systems and reconstruction of electrical installations are set by the Rules for the installation of electricity generating equipment [4]. These requirements are as follows: perspective of development of power systems and power supply systems, taking into account rational combination of newly constructed electric grids with existing and newly constructed networks of other voltage classes; provision of integrated centralized power supply to all consumers of electrical energy located in the coverage area of electrical networks, regardless of their affiliation; limitation of short-circuit currents to limit levels defined for the future; reduction of losses of electric energy; compliance of decisions with environmental conditions. Simultaneously with such requirements, should be considered external and internal power supply, considering the possibilities and economic feasibility of technological redundancy.

It is also important to notice the requirements regarding the lighting of spaces in the building divided into internal and external. By nature, lighting can be divided into light-and-dark, light-tonal, local and silhouette. Light-and-dark is the kind of lighting when radiation source forms light from the shadow, and diffused light highlights the shadows of the object. Light-tonal is the lighting when scattered light uniformly fills the space and illuminates all points of the object being photographed. Local lighting is the lighting of a limited part of certain space or part of the object being photographed. Silhouette is the lighting, when the objects in the foreground are darkened, and the light falls to the background [5]. The latest advances in lighting technology include

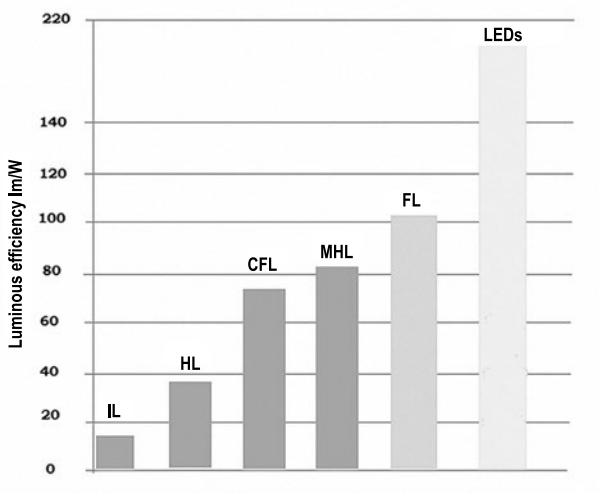

Fig. 1. Luminous efficiency of different types of Lamps

fluorescent lamps, various types of laser illuminators, used both for practical purposes, for example, in measurements of atmospheric pollution, in light reflection, and for decorative illumination of miscellaneous objects [6]. For example, fixtures with fluorescent lamps (these are the ones used in factories) should be used with ballasts that provide a power factor of at least 0.9 with light fixtures for two lamps and more and 0.85 for single-lamp fixtures. Design of the lamp is quite a simple one. Into a hollow flask filled with an inert gas and mercury vapour, electricity is supplied through the electrodes. There appears a discharge that causes ultraviolet radiation and a luminophor glow. This substance is applied by the manufacturers to the inner surface of the tube. It is important to note, that the lamp is safe for the human eye – the glass prevents penetration of ultraviolet radiation beyond the bulb. The exception is the special anti-bacterial lamps, originally designed to combat pathogens and dangerous viruses. The bulb in such light fixtures is made of quartz glass. The main classification of lamps of a luminescent type includes four categories of devices (Table 1).

Such lamps have, of course, both their advantages and disadvantages. The advantages include: possibility of long-term operation; high efficiency (up to 25 %); increased luminous efficiency (compared with an incandescent lamp, an increase of 10 times is observed); possibility to use lighting of different spectrum; low cost of the device. However, certain shortcomings also exist, such as: hazardous effect of the tube contents for the environment; dependence on switching on and off (over time, quality of lighting decreases); dependent on voltage fluctuations; cannot be used without a trigger; dependent on air temperature (less for models with semiconducter ballast). In comparison with incandescent lamps, which, in turn, gradually lose their importance in the use of various organizations, they are actively used by owners of enterprises, organizations, etc. An incandescent lamp (IL) is an electric light source that emits light as a result of the heating of a conductor made of refractory metal (tungsten). Tungsten has the highest melting point among all pure metals (3693 K). The filament is confined in a glass flask filled with an inert gas (argon, krypton, nitrogen). The inert gas protects the filament from oxidation. The glass bulb prevents the negative effect of atmospheric air on the tungsten filament. The advantages of this kind of light fixture include: low cost; instantaneous ignition when switched on; small overall dimensions; wide power range. The disadvantages are: greater luminance (negatively affects the eyesight); short service life – up to 1000 hours; low efficiency (only one tenth of the electric energy consumed by the lamp is converted into a visible light flux, the rest of the energy is converted into thermal energy). Due to their shortcomings, which are significant, such lamps are inferior to luminescent lamps when used in large enterprises. Luminous efficiency of different types of Lamps is presented in Fig. 1

When considering the use of working light, it is recommended to supply it on independent lines from switchgear of substations, boards, cabinets, distribution points, trunk and distribution busbars. In industrial, public and residential buildings, up to 60 incandescent lamps, each with a power of up to 60W, can be connected to single-phase lighting groups of stairways, corridors, halls, technical subfloors and attics. This refers to a grouped network where lines must be protected by fuses or circuit breakers. For outdoor lighting, any light source can be used. The use of discharge lamps is not permitted for the security lighting of the enterprise territories, in cases where the security lighting is not normally turned on and is automatically turned on by the security alarm. It is recommended to make outdoor lighting networks using cable or air using self-supporting insulated wires. In addition, for such illumination the lighting fixtures themselves can be installed on specially designed supports. To ensure the right and proper illumination light guides are needed. Currently, most enterprises use lighting devices with hollow light guides. They are necessary for general uniform internal illumination; illumina-

Table 2. Energy Consumption and Savings

Lighting object location	Basic energy consumption, 10^{15} J / year	Potential of savings, %	Savings (low), 10^{15} J	% of total savings	Savings (high), 10^{15} J	% of total savings
Electric lighting						
In residential apartments	5604	40–60	2242	25	3362	27
In commercial buildings	9551	25–40	2388	27	3821	31
In industry	3272	15–25	491	6	818	7
Street lighting, etc.	1507	25–50	377	4	753	6
Lighting on fuel (kerosene)						
In residential apartments	3603	92–99	3300	38	381	29
Total	**23536**	**37–52**	**8797**	**100**	**12335**	**100**

tion of territories, open spaces and streets; the introduction of buildings and distribution in them both direct sunlight and artificial light. Lighting devices with Hollow Light Guides [7] are hollow cylindrical (or other forms) pipes of a large extent, part of the inner surface (or the entire surface) of which is covered over the entire length by a specularly reflective layer or prismatic film of total internal reflection, while the light flux (of the IC or the group of lamps) is introduced into the ends of the PPS by special optical systems. The Fig. 2 shows the possibilities of saving electricity in lighting installations with fluorescent lamps.

Electrical networks of buildings must be designed to supply the lighting of advertising, shop windows, facades, illuminating, outdoor, fire-fighting devices, dispatching systems, light fire hydrant signs, security sign, bell and other signalling, light barriers, etc. in accordance with the design task. Iluminated surface luminance depends on the intensity of the light source and the nature of the surface itself [8]. It is always less than the luminance of the light source, since a part of the light is absorbed by the illuminated surface, another part is scattered in different directions and only the third part of it is reflected in the direction, from which the surface is viewed. Abroad, studies and experiments were conducted on the influence of lighting on human performance, and also in order to identify possible criteria for the normalization of illumination. “The following indicators were investigated: PT (labour productivity, speed of proof-reading work), visual fatigue (for a relative change in the time of chromatic adisparopy, visibility and luminance of the source at the comfort-discomfort boundary). The following conclusions were drawn from the results of the studies: as a rule, the increase in illumination leads to the growth of PT, but with excessive increase in illumination, fatigue increases” [9]. The Table 2 shows an example of energy savings for different lighting object locations.

Reasoning from the previously said, it can be argued that the energy costs for the production and use of light energy determine to a large extent the lighting level of the industry and the country as a whole. The degree of development of the states can be characterized to the greatest extent not so much by the volumes of steel and pig iron smelting, the extraction of oil or gas, the number of manufactured machines and locomotives, as the “light provision” of this state while minimizing energy consumption.

Security is what is important and what each of us strives to provide. To achieve that, we need to equip ourselves with a certain set of knowledge that will help to prevent emergencies. So, for example, after the disconnection of switches, disconnectors (separators) and load switches with manual control take place, it is necessary to visually verify that they are truly disconnected and there are no bridging

Table 3. Permissible Levels of Magnetic Field

Duration of stay (hour)	Permissible levels of magnetic field H (A / m) / V (μT) when exposed	
	generally	locally
≤ 1	1600/2000	6400/8000
2	800/1000	3200/4000
4	400/500	1600/2000
8	80/100	800/1000

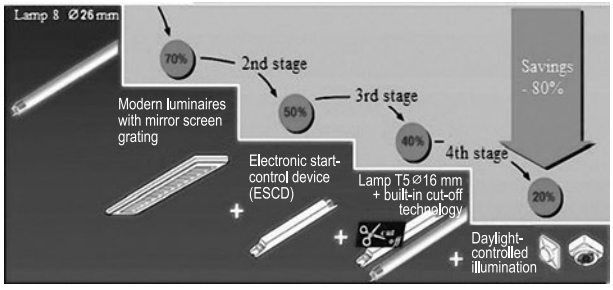

Fig. 2. Stages for energy savings

jumpers [10]. Labour protection is also envisaged for checking the absence of electric voltage. This should be done with the help of special instruments designed for this purpose or by approaching current-carrying parts that are known to be energized. In pre-fabricated switchgear factory-made, the test is performed using built-in stationary voltage indicators. One of the measures may also be the "hanging of prohibitory posters" [11]. For example, on the actuators (handles of drives) of switching devices with manual control, such posters as "Do not switch on! Workers are present!" should be used. Devices that signal the disconnected position of the machinery, blocking devices, and permanently connected voltmeters are only additional means of confirming the absence of voltage, and on the basis of their indications, it can not be concluded that there is no voltage in the electric system. Voltage dips occur in networks when switching power from one source to another without first disconnecting the load [12].

It is important to mention the magnetic field created by the interaction of the conductor with the current. Conductors with electric current act on each other by means of magnetic forces. Moving electric charges (currents) create a magnetic field. In the open switchgear and on the overhead line with a voltage of 330 kV and above, protection of workers from a biologically active electric field, which can have a negative effect on the human body and cause the appearance of electrical discharges when touched to grounded or ground-insulated electrically conductive objects, has to be properly organised. In electrical installations of all voltages, workers must be protected from a magnetic field, which can have a negative effect on the human body. In the Table 3 you can see the permissible levels of the magnetic field.

Also, labour protection is very important when working with portable power tools and lamps, manual electric machines, separation transformers. First of all, all these devices must meet the technical regulations requirements, national standards and technical conditions in terms of electrical safety and be used in compliance work. It is not allowed to use manual electric machines, portable power tools and lamps with associated auxiliary equipment, which have defects and have not passed periodic inspection (tests). Fixtures are intended, as a rule, to illuminate relatively closely located objects or light signals at short distances. Two or more lamps may be installed in light fixtures (in multi-lamp chandeliers, for example, the number of lamps can go as high as to hundreds and even thousands of units). Fixtures for lighting (unlike signal lamps) are, as a rule, abbreviated as luminaires [1]. When using portable luminaires, their wires and cables should, if possible, be suspended. Do not directly touch wires and cables with hot, wet and oily surfaces or objects. Electric cable should be protected from accidental mechanical damage and contact with hot, moist and oily surfaces. If any malfunctions are found, the work must be stopped immediately.

4.CONCLUSION

We can assert with confidence that technical progress does not stand still. Of the major achievements of recent years, creation of a huge variety of

solid-state emitters – LEDs and solid-state lasers can be named. In these light sources electric energy directly transforms into optical radiation, which allows to establish contact light displays and panels, widely used in modern devices and computers. In the end, progress in the development of lighting technology is determined by the success in the study of physical processes. The major achievements of STEM disciplines of the past century were made possible by the creation of scientific instruments. As a result of the improvement of technical equipment of enterprises, primarily state-owned, which have great importance for the economy of the state, it is possible to increase the level of power supply efficiency, minimize risks, accidents and emergencies in order to avoid negative consequences for the individual.

REFERENCES

1. Shepeleva D.V. State-owned enterprise as a subject of financial law: Thesis for a PhD in Law. MSLA. Moscow, 2016. 218 p.

2. Andreeva L. Energy - clear legal regulation // the Russian justice, 2001, #8.

3. Ahmad M.W., Mourshed M., Rezgui Ya. Trees vs Neurons: Comparison between random forest and ANN for high-resolution prediction of building energy consumption // Energy and Building, 2017, Vol. 147, pp. 77-89.

4. Rules and regulations of electrical installations arrangement [Text]: All applicable sections of EIC-6 and EIC-7, Novosibirsk: Normateca, 2017, 464 p.

5. Mayorova O.V., Mayorov E.E., Turkbaev B.A. Lighting engineering. SPbGUITMO, 2005. p. 86.

6. Ishunin G.G., Kozlov M.G., Tomskij K.A. The basics of lighting engineering. SPb. // Beresta, 2004, p. 292.

7. Hollow Light Guides Technology and Application. 164-2005 CIE Technical Report. 37 p.

8. Aizenberg Yu.B. The reference book on light engineering 3rd edition // Znak publ., Moscow, 2006, 962 p.

9. H. Claude Weston. The relation between illumination and visual efficiency, the effect of brightness contrast // H.M. Stationery off, London, 1945, 35 p.

10. Sivkov A. A., Gerasimov D. Yu., Saigal A. S. The basics of power supply // Publishing house of Tomsk Polytechnic University, Tomsk, 2012, 180 p.

11. Rules for labor protection and operation of installations // ENAS publ., Moscow, 2017, 190 p.

12. Vafin D.B. Energy supply for enterprises // NHTI (branch) of FSBEI HPE "KNRTU, Nizhnekamsk, 2013, 104 p.

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