FUNCTIONING OF ELECTRICAL ENERGY ACCUMULATION SYSTEMS: PROPOSALS FOR THE DEVELOPMENT OF LAWS ON THE ELECTRICAL ENERGY INDUSTRY

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Electrical energy accumulation systems refer to technologies, the use of which can entail organizational and technological changes in the management and functioning of electrical energy systems and facilitate the transition of the energy industry to a new technological basis. Functioning of electrical energy accumulation systems within the energy system facilitates the solution of the task of raising reliability and quality of energy supply to consumers ensuring economic efficiency of the accompanying services and integration of generating facilities functioning on the basis of renewable energy sources in the energy system. At the same time, regulations governing relations in the electrical energy industry need to be amended to ensure participation of accumulation systems in the electrical energy (power) circulation and their safe operation within the electrical energy system. The paper describes the content of the main amendments to the industrial regulation aimed at integration and development of accumulation systems in the electrical energy industry that can be elaborated in the future within the framework of further research.

Keywords: *energy law, legal regulation in the electrical energy industry, electrical energy accumulation systems.*

In accordance with the Energy Strategy of the Russian Federation for the Period up to 2035, one of the main areas of activities aimed at the development of the domestic energy industry is efficient satisfaction of demands of the socioeconomic development of the Russian Federation with the respective volume of manufacture and export of products and services of the fuel and energy complex [1].

Within the framework of the indicated trend, the electrical energy industry is facing a task of raising reliability and quality of energy supply to consumers up to a level comparable to the best foreign analogues, ensuring economic efficiency of such services.

Solution of the task of the electrical energy industry implies the implementation of measures related to ensuring participation of electrical energy accumulation systems ("EEAS") in electrical energy (power) circulation and rendering of accompanying services [2].

The main functions of EEAS are the opportunity to use them as a primary and

emergency energy source, management of the consumption schedule, regulation of system parameters of the energy system (frequency, voltage) for the purposes of saving, reduction of electrical energy losses and raising its quality [3].

The use of EEAS in the electrical energy industry also facilitates integration of generating facilities functioning on the basis of renewable energy sources in the energy system, gradual decommissioning of traditional generation equipment, optimization of energy supply costs, ensuring reliable and stable functioning of the energy system [4]. Thus, EEAS fairly refer to technologies, the use of which can entail organizational and technological changes in the management and functioning of electrical energy systems and facilitate the transition of the energy industry to a new technological basis (the so-called "energy transition").

Today, there remain open the conceptual issues of the status of EEAS as a separate equipment type, their legal regime, rules for their use in the electrical energy industry and operations at wholesale and retail markets using them.

The results of the public hearing of the draft of the resolution of the Government of the Russian Federation on the issues of functioning of EEAS in the electrical energy industry [5] show that it needs to be substantially revised in the following areas:

— referring of EEAS to a specific type of an electrical energy facility and development of the EEAS owner definition;

— use of EEAS in the system of economic relations involving circulation of electrical energy and power on the wholesale market and within the framework of functioning of retail electrical energy markets;

— technological connection of EEAS to electrical grids;

— opportunity to use EEAS by grid operators in rendering of electrical energy transmission services;

— technological requirements for functioning of EEAS within the energy system and operational dispatch management of EEAS.

Creation of legal conditions for EEAS functioning will require significant amendments to the legal acts regulating relations in the electrical energy industry.

Let us review the content of the main amendments to the laws on the electrical energy industry required for the participation of EEAS in circulation of electrical energy (power) and rendering of accompanying services.

Firstly, there is a need to establish the legal regime of EEAS within the framework of industrial regulation and give a definition of the EEAS owner.

In accordance with Art. 3 of the Law on the Electrical Energy Industry, [6] items of property directly used in production and transmission of electrical energy, operational dispatch management in the electrical energy industry and sale of electrical energy including power grid facilities are referred to facilities of the electrical energy industry.

As EEAS need to be referred to a specific type of an electrical energy facility, let us briefly describe their structural features and the principle of operations.

An EEAS consists of three main elements: the lithium-ion accumulation subsystem (racks with accumulation facets that store energy), the transformation subsystem (inverter) and the management subsystem to control the status of EEAS subsystems and transmit information on their relevant technical status. The mentioned EEAS elements are technologically linked with a process ensuring accumulation and storage of electrical energy for its further use (output into the energy system).

Pumped storage power plants are an analogue of EEAS; their technology allows consuming excess power in the energy system during minimum load hours (pumping mode) and releasing power into the energy system during peak load hours (generating mode)

making the load schedule more even and covering consumption peaks.

Thus, EEAS are closer to electrical energy production facilities in terms of their designation and technological features of operation.

Regardless of the fact that EEAS are not designed to establish electrical connections and transmit electrical energy, they can be used by grid operators to raise reliability and quality of electrical energy transmission services and reduce losses in electrical grids, so it is incorrect to rely on the assumption that EEAS can be owned only by electrical energy producers, grid operators or consumers.

The noted EEAS features allow wording their definition, which is worth including in the Rules for the Wholesale Electrical Energy and Power Market ("WEM Rules") [7]:

EEAS mean a complex of primary and auxiliary equipment and software technologically interrelated by the process transforming electrical energy in the energy form that can be saved, storage of such energy and further transformation to electrical energy. This definition of EEAScan potentially be treated as universal for the wholesale and retail electrical energy markets.

It is also worth enshrining in the WEM Rules that any person holding EEAS connected to electrical grids entering the Unified Energy System of Russia or technologically isolated territorial electrical energy systems based on the right of ownership or other legal ground can be the EEAS owner.

The issues of EEAS participation in the wholesale trade in electrical energy and power need to be reviewed separately.

Since the main EEAS function is storage of energy and its transformation to electrical energy, EEAS owners planning to take part in wholesale trade in electrical energy and power need to be equaled to suppliers and EEAS themselves need to be equaled to generation equipment and electrical energy production facilities.

Taking into account that EEAS owners are equaled to suppliers on the wholesale market, it would be reasonable to specify quantitative characteristics to be complied with by a supplier to obtain the status of a wholesale market subject as an electrical energy supplier can own not only generation equipment with the established generation capacity of at least 5 MW in each of the intended groups of supply points, but also EEAS with equal established capacity.

Today, high-power EEAS are used primarily in the pilot mode (examples: EEAS tests at the Burzyanskaya solar power station and the Kosh-Agachskaya solar power station). Considering that this technology is new, the requirement of Clause 31 of the WEM Rules that persons owing electrical energy production facilities with the established generation capacity of 25 MW and more have to sell all produced electrical energy (power) only on the wholesale market, seems redundant.

In order to allow an EEAS owner to select a market, where the participation seems to make economic sense, the WEM Rules need to specify that the requirement concerning the sale of all produced electrical energy on the wholesale market will not cover EEAS holders with the established generation capacity of 25 MW and more.

As the amendments introduced in the WEM Rules should reflect the features of trade in electrical energy and power with the use of EEAS, it is necessary to set the procedure for calculation of the maximum volume of EEAS power supply to the wholesale market considering features of the EEAS technology and the impossibility of endless power supply to the market as well as determine the procedure for calculation of power volume actually supplied to the wholesale market with the use of EEAS following the results of competitive power selection. Features of submission and competitive selection of price quotes one day in advance need to be reviewed separately to balance the system.

It should be noted that the introduction of the mentioned amendments to the WEM Rules will require specification of the wholesale market trade system accession agreement and wholesale market regulations.

In particular, the relevant amendments need to be introduced in the regulation on access to the wholesale market trade system, provision on the procedure for obtainment of the wholesale market subject status, regulation on price quote submission by wholesale market participants, regulation on competitive selection of price quotes one day in advance, regulation on competitive selection of applications to balance the system, generation equipment certification regulation.

As EEAS participation is also required within the framework of retail electrical energy markets, amendments need to be introduced to the Fundamental Provisions on Functioning of Retail Electrical Energy Markets ("Fundamental Provisions") [8].

By analogy with the WEM Rules, the Fundamental Provisions should equal an EEAS owner to an electrical energy producer on the retail market and EEAS should be equaled to generation equipment (power station) of an electrical energy production facility.

It makes no sense to give an EEAS definition in the Fundamental Provisions as the latter indicate that other terms have the meaning given to them in other regulations.

Nevertheless, it is worth noting in the Fundamental Provisions that there should be no registered groups of supply points on the wholesale market with regards to EEAS used on retail electrical energy markets and an EEAS owner plans to sell or sells electrical energy on retail markets.

Moreover, it seems reasonable to enshrine that in order to record volumes of electrical energy produced by EEAS, recording devices should be installed at the border of the balance inventory of EEAS and other facilities of the electrical energy industry or power receivers owned by related facilities of the electrical energy industry and consumers accordingly. The list of transferred data on EEAS production volumes will also have to be detailed taking into account their technological features.

The described areas of amendments to the WEM Rules and the Fundamental Provisions will allow laying the foundation for EEAS participation in circulation of electrical energy (power) on wholesale and retail markets. At the same time, the issues related to EEAS functioning within the energy system need to be reviewed separately.

For the purposes of technological support of EEAS operation within the energy system, one first of all needs to settle any issues related to connection to electrical grids, which will require amendments to the Rules for Technological Connection of Power Receivers, Electrical Energy Production Facilities ... to Electrical Grids ("TC Rules") [9].

In order to apply TC Rules, EEAS planned to be used for electrical energy output also have to be equaled to an electrical energy production facility or power station and it should be noted that they cannot be held on the right of ownership or other legal ground by a grid operator.

Amendments should also be introduced to the requirements for the content of a technological connection application (as the existing requirements for an application for connection to electrical grids do not take into account specific capacity and time-related technical characteristics of EEAS), determination of the maximum EEAS capacity, maximum and established capacity of electrical energy production facilities using EEAS and criteria of approval of technical conditions for technological connection of EEAS with the operational dispatch management subject.

TC Rules can be supplemented with requirements that allow assessing the EEAS impact on the load of the facility for the external grid at set EEAS parameters (inverter capacity, storage system volume, admissible

power output rate) and a standard load profile of a connected consumer as EEAS are now basically absent from any methodologies used to calculate loads for technological connection purposes.

Besides, what needs to be covered is that EEAS can be used as a reserve power source if EEAS are able to ensure uninterrupted operation of electrical energy production facilities or consumer's power receivers within the period of time required to recover energy supply from the electrical grid. It should be taken into account that due to their nature, EEAS cannot operate autonomously for a long period of time, so it is reasonable to determine the requirements for the duration of EEAS functioning as a reserve power source.

As mentioned earlier, EEAS can be used by grid operators to raise reliability and quality of electrical energy transmission services and reduce losses in electrical grids. As such, it is reasonable to establish legal grounds for holding and use of EEAS by grid operators.

This issue should be regulated by the Rules for Undiscriminated Access to Electrical Energy Transmission Services and Rendering of Such Services ("UA Rules") [9] that need to enshrine that EEAS are equaled to power grid facilities of grid operators used by the latter to render transmission services and perform technological connection of power receivers to electrical grids.

A disclaimer should be made that grid operators cannot sell any electrical energy produced (transformed) with the use of EEAS. Such disclaimer will make is possible to specify the procedure for the use of EEAS by grid operators and avoid any violations of the prohibition to combine natural monopoly and competitive activity types in the electrical energy industry [10].

Among other matters, UA Rules need to establish the procedure for the calculation of the cost of electrical energy transmission services rendered by a grid operator to an EEAS owner. Taking into account the specifics of technical parameters of EEAS (certain useful power output, maximum long-term discharge and charging current), it is reasonable to calculate the cost of electrical energy transmission services rendered by a grid operator to an EEAS owner based on the hourly volume of supplied electrical energy.

In order to ensure reliable and safe EEAS operation within an electrical energy system, it is important to set technological requirements for EEAS functioning and it will be necessary to amend the Rules for the Technological Functioning of Electrical Energy Systems ("RTF") [11].

RTF provisions need to be extended to cover EEAS owners planning to take part in the production (transformation) and output of electrical energy to an electrical grid. It is also reasonable to extend the requirements for ensuring reliability of electrical energy systems, reliability and safety of facilities of the electrical energy industry and power receivers to cover owners of accumulation systems.

In order to ensure EEAS functioning in the energy system, RTF has to enshrine the determination of such general system technical parameters for EEAS as established (nominal) and maximum available power in the electrical energy production (transformation) and consumption modes, capacity and time characteristics, active power alteration rate, range limits of active and reactive power. Besides, RTF will have to be detailed in terms of peculiarities of participation of energy accumulation systems in the frequency and voltage regulation in performance and emergency control.

The issues related to the operational dispatch management of EEAS need to be reviewed separately.

Thus, management of the operational status and the technological mode of EEAS operation will require amendments to the Rules for Referring of Subjects of the Electrical Energy Industry and Electrical Energy Consumers to the Range of Persons Subject to Obligatory Servicing at Rendering of Operational Dispatch Management Services

in the Electrical Energy Industry [12]; the Rules need to establish that EEAS functioning within an electrical energy system used to produce and sell electrical energy and (or) power is equaled to a power station.

The listed areas of amendments to the acts of the Government of the Russian Federation concerning the issues of EEAS functioning in the electrical energy industry will need to be further specified by acts of the Ministry of Energy of Russia that establish requirements for reliability of electrical energy systems, safety and operation of facilities of the electrical energy industry and power receivers, provision of information for operational dispatch management, development and approval of power output diagrams and external energy supply diagrams, design or normal (temporarily normal) diagrams of electrical connections of facilities of the electrical energy industry, consumption forecasting, establishment of balance of electrical energy and power of an energy system.

Summing up, it should be noted that in conditions of the transition of our country to clean and resource saving energy industry, problems of the legal regulation of EEAS participation in electrical energy (power) circulation and rendering of accompanying services becomes relevant.

The electrical energy industry is already implementing a number of projects aimed at EEAS development and integration (implementation of an EEAS introduction roadmap by Rosseti, PJSC; creation of a working group to implement projects of EEAS integration in the unified energy system based on solar power stations at the participation of Systemic Operator of the Unified Energy System, JSC, and Avelar Solar Technology, LLC; conducting tests of EEAS at the Burzyanskaya solar power station and the Kosh-Agachskaya solar power station).

The legislator is facing comprehensive work on preparation of amendments to the system of regulatory acts governing relations in the electrical energy industry. The concept of the abovementioned changes of the industrial regulation is aimed at delineation of essential legal grounds for EEAS functioning in the electrical energy industry that may be specified within the framework of further research. ■

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