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# LEGAL REGULATION OF ELECTRICAL ENERGY STORAGE SYSTEMS

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**Abstract.** Electrical energy storage systems contribute to the integration of generating facilities operating on the basis of the use of renewable energy sources into the energy system, the gradual decommissioning of traditional generation equipment, optimization of the cost of energy supply, ensuring reliable and sustainable operation of the energy system. The Energy Strategy of the Russian Federation for the period up to 2035 provides for the need to ensure energy storage systems for the circulation of electrical energy (capacity) and the provision of related services. However, fundamental issues related to the legal status and qualification of storage systems as a separate type of equipment remain open. The paper presents approaches to changing the regulations of the Government of the Russian Federation in order to establish the legal regulation of electrical energy storage systems.

**Keywords:** energy law, energy strategy, laws on electrical energy industry, electrical energy storage systems.

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The objective of the electrical energy industry within the framework of the Energy Strategy of the Russian Federation for the period up to 2035 is to increase the reliability and quality of energy supply to consumers to a level comparable to the best foreign analogues, while ensuring the economic efficiency of such services [1].

In accordance with the action plan for the Energy Strategy implementation, in order to solve this problem, it is necessary to ensure the involvement of electrical energy storage systems (hereinafter the "EESS") in the circulation of electrical energy (capacity) and the provision of related services [2].

The preparation of a regulation of the Russian Government aimed at establishing the legal grounds for the participation of EESS owners in the trade of electrical energy and/or electrical capacity in the wholesale market and retail electrical energy markets is also provided for by the updated action plan (roadmap) to improve laws and eliminate administrative barriers in order to ensure the implementation of the EnergyNet National Technology Initiative [3]. The specified regulation must contain the concept of 'electrical energy storage system' and 'electrical energy storage system owner'.

Currently, the industry has developed a situation in which projects related to the integration of EESS into the energy system are already being implemented by market participants (large-scale launch of storage systems in the regions of presence of PJSC Rosseti Center; implementation of the 'EESS-Based Commercial Dispatching' Pilot Service Project by RENERA LLC and JSC Atomenergopromsbyt; development of an innovative hybrid energy storage system by PJSC RusHydro, an increase in the cases of operation of EESS as part of generating facilities operating on the basis of the use of renewable energy sources).

At the same time, the conceptual issues of the legal status and qualification of storage systems as a separate type of equipment remain open.

In accordance with Article 3 of the Law on the Electrical Energy Industry [4], electrical energy facilities include facilities directly used in the process of generation, transmission of electrical energy, operational dispatch control and sale of electrical energy, including electric grid facilities.

The functions of EESS in the electrical energy industry differ depending on their use by the electrical energy industry entities that own electrical energy generation facilities or electric grid facilities.

For generating companies, the EESS, located within the boundaries of the balance ownership of the electrical energy generation facility, is able to increase the efficiency of the power station, and the accuracy of the load schedule. The storage system can be part of a 'system' power station, a small or local station, as part of a generating facility operating on the basis of the use of renewable energy sources (SPS/WPS) [5].

For electrical energy generators, EESS are attractive due to their wide control range compared to power units of thermal power stations, substitution of peak generation, the possibility of optimizing fuel costs, maneuverable power for NPS, SPS, and WPS [6].

The use of EESS by a grid operator can improve the reliability of power supply, reactive power compensation, compensation of higher harmonics, reduce losses in grids, and increase equipment throughput capacity. A typical situation for the use of EESS by a grid operator is to cover the peaks of an overloaded substation during periods of maximum loads, that is, peak loads that occur at certain hours and periods, to provide a backup power source in the event of an accident according to the N-1 Criterion (covering the peak load in the event of a transformer failure during the peak period).

In general, the use of EESS in the electrical energy industry also contributes to the integration of generating facilities operating on the basis of the use of renewable energy sources into the energy system, the gradual decommissioning of traditional generation equipment, optimization of the cost of energy supply, ensuring reliable and sustainable operation of the energy system.

It should be noted that an EESS includes the following three main elements:

- Li-ion storage subsystem (specifically, stands with storage cells that store energy);
- Conversion subsystem (inverter); and
- Control subsystem that allows you to control the state of the EESS subsystems and transmit information about their current technical condition.

The above elements of the EESS are technologically connected by a process that ensures the storage of electrical energy for the purpose of its subsequent use (delivery to the power system).

The national standard, GOST 58092.1–202, states that an electrical energy storage is an installation capable of absorbing electrical energy, storing it for a certain time and giving off electrical energy, during which energy conversion processes can occur. In turn, an EESS is defined as an electrical installation with certain boundaries, including engineering structures, energy conversion equipment and related auxiliary equipment connected to the electrical network, including at least one electrical energy storage (ESS) that extracts electrical energy from the electrical energy system, stores this energy inside itself in some form and gives it back to the electrical energy system.

It should be noted that the analogue of the EESS are PSPs, the technology of which allows to consume excess power in the power system during the hours of minimum loads (pumping mode) and to deliver power to the power system during the hours of maximum loads (generator mode), ensuring a reduction in the degree of unevenness of the load schedule and coverage of consumption peaks [7]. However, unlike the generator, the energy storage system will require an additional resource of the power system to restore the adjustment range. In addition, most li-ion batteries have a speed limit (at faster discharge rates, battery life begins to decline rapidly, and the number of complete charge/discharge cycles begins to decrease).

The main parameters of the EESS are: output/input active power, normalized output active power, normalized total power, operating time (including the necessary load support time, recovery time), energy intensity, number of charge-discharge cycles, maximum discharge/charge current, allowable charge/discharge current, operating range for regulation, service life and efficiency output.

Let us consider the main changes that need to be made to the regulations of the Russian Government in order to establish the legal status of energy storage systems.

**1. The Rules of the Wholesale Electrical Energy and Power Market enacted by the Russian Government Decree No. 1172 dated December 27, 2010 (the "Wholesale Market Rules").**

The Wholesale Market Rules can potentially become a backbone regulation in terms of issues related to the definition of energy storage systems.

In terms of their purpose and technological features of their operation, EESS is closer to generating equipment, but it does not follow that they can belong exclusively to electrical energy generators or consumers with their own generation. As mentioned earlier, EESS can also be used by grid operators in order to improve the reliability and quality of electrical energy transmission services, as well as reduce losses in electrical grids.

Taking into account that the above elements of EESS are interconnected by a process that ensures the storage of electrical energy for the purpose of its subsequent release to the power system, it is advisable to indicate in the definition of EESS that they are objects of the electrical energy industry, including a set of main and auxiliary equipment, as well as software. Besides, the specified equipment and software are technologically interconnected by a process that ensures the conversion of electrical energy into a form of energy that can be stored, as well as the storage of this energy and subsequent conversion into electrical energy. In our opinion, it would be wrong at the regulatory level to "blur" the definition of EESS depending on the purpose. That is, storage systems cannot be simultaneously defined as electrical energy generation facilities, electric grid facilities or power receivers.

The definition of EESS can potentially be considered universal for the wholesale and retail electrical energy markets.

Based on the definition of the EESS, it becomes possible to form a definition of the "electrical energy storage system owner", whereto it is advisable to attribute persons who own (including indirectly) the EESS connected to the electric grids that are part of the Unified Energy System of Russia or technologically isolated territorial electrical energy systems on the right of ownership or another legal basis.

As for the issues of integration of storage systems into the wholesale market of electrical energy and capacity, the Wholesale Market Rules need to fix that the owners of EESS who plan to participate or participating in the purchase and sale of electrical energy and capacity in the wholesale market using EESS align with the suppliers, and the very storage systems align with the generating equipment and electrical energy generation facilities. Besides, the Wholesale Market Rules should establish that in terms of SCIGE and generating equipment in reserve, suppliers must provide the system operator with information about the parameters of the EESS.

Separate elaboration in order to establish the legal regime of storage devices requires issues related to the location of the DPC of electrical energy entities and consumers of electrical energy, as well as the extension of the obligation to the EESS owners, established in Clause 31 of the Wholesale Market Rules, related to the sale of all generated electrical energy (capacity) in wholesale market, if the installed generating capacity of the facility for the generation of electrical energy is equal to or exceeds 25MW. The application of the obligation specified in Clause 31 of the Wholesale Market Rules in relation to the owners of EESS is a debatable issue.

After the public discussion of the first edition of the draft decree of the Russian Government on the functioning of the EESS in the electrical energy industry, some market participants noted that such a requirement is redundant, since the EESS technology is relatively new. In our opinion, the existing practice of using EESS in the electrical energy industry makes it possible to extend to EESS owners the obligation to sell the generated electrical energy in the wholesale market.

It should be borne in mind that the introduction of the listed changes to the Wholesale Market Rules will require detailing the agreement on joining the wholesale market trading system, as well as the regulations of the wholesale market.

**2. Basic Provisions for the Functioning of Retail Electrical Energy Markets, approved by the Russian Government Decree No. 442 dated May 4, 2012 (hereinafter the "Basic Provisions")**

In order to regulate the legal status of EESS, amendments to the Basic Provisions are required.

As is the case with the wholesale market, it is advisable to equate the EESS owner with the electrical energy (capacity) generator in the retail market, and the EESS with the electrical energy (capacity) generation facility (generating equipment, power stations), provided that the following conditions are met in aggregate:

There is no Delivery Point Cluster registered in the wholesale market in relation to the EESS of such an owner;

The EESS owner plans to sell or sells electrical energy (capacity) in the retail markets of electrical energy generated (converted) by the EESS.

Separately, it is necessary to work out the issue of the transmitted data on the volumes of the EESS electrical energy generation. In particular, the transmitted data may contain information on hourly volumes of electrical energy generation determined by the indications of calculation (control) metering devices located on the ownership demarcation point of the EESS and other electrical energy industry facilities (power receivers) owned by related electrical energy industry entities.

**3. Electrical Energy System Process Operation Rules approved by the Russian Government Decree No. 937 dated August 13, 2018 (the "POR")**

In order to establish the legal regime of energy storage systems, changes in the POR are required.

First, applicable to the EESS should be the requirements of the Process Operation Rules for electrical energy generation facilities, as well as requirements for ensuring the reliability of electrical energy systems, reliability and safety of electrical energy facilities and power receiving installations, in relation to electrical energy industry entities and electric energy consumers who own electrical energy generation facilities on an ownership basis or other legal basis.

Second, applicable to the EESS should be such system-wide technical parameters as the installed (nominal) and peaking available capacity in the generation mode (conversion into electrical energy) and electrical energy consumption mode, power-time characteristics, the active power ramp rate, the active power adjustment range, the reactive power adjustment range, readiness to participate in general primary frequency control.

Similarly to the generating equipment of a power station, EESS that are in operation or in reserve must be ready to operate within the entire active and reactive power adjustment range.

Besides, it is necessary to ensure that the EESS can be used as a backup power source in the case of the ability of the EESS to ensure continuous operation of

electrical energy generation facilities or power receivers of the consumer for the period of time required to restore power supply from the electric grid.

Potentially, in order to regulate the legal regime of EESS, it may be required to amend the Rules for the Technological Connection of Power Receivers of Electrical Energy Consumers, Electrical Energy Generation Facilities, as well as Electric Grid Facilities owned by grid operators and other persons, to electric grids, approved by the Russian Government Decree No. 861 dated December 27, 2004. It is advisable to make changes in terms of the requirements for the content of the EESS owner's application for technological connection (since the existing requirements for the application for connection to electric grids do not take into account the presence of specific power-time technical characteristics of the EESS), determining the peaking EESS capacity, the peaking and installed capacity of electrical energy generation facilities that use EESS, as well as criteria for the approval of technical conditions for the technological connection of the EESS with the operational dispatching management system.

**Conclusion**

Thus, the legal regime of electrical energy storage systems is characterized as follows:

- The functions of EESS differ depending on their use by the electrical energy industry entities that own electrical energy generation facilities or electric grid facilities;
- EESS are the electrical energy industry facilities comprising a set of main and auxiliary equipment, as well as software, and technologically interconnected by a process that ensures the conversion of electrical energy into a form of energy that can be stored, as well as the storage of this energy and subsequent conversion into electrical energy;
- Storage systems cannot be simultaneously defined solely as electrical energy generation facilities, electric grid facilities or power receivers;
- It is advisable to consider the EESS owner as a person who owns, on an ownership basis or other legal basis, the EESS connected (including indirectly) to the electric grids that are part of the Unified Energy System of Russia or technologically isolated territorial electrical energy systems;
- As is the case with the wholesale market, it is advisable to align the EESS owner with the electrical energy (capacity) generator in the retail market, and the EESS — with the electrical energy (capacity) generation facility (generating equipment, power stations); and
- Applicable to the EESS should be the requirements of the Process Operation Rules for electrical energy generation facilities, as well as the requirements for ensuring the reliability of electrical energy systems, the reliability and safety of electrical energy facilities and power receiving installations, in relation to electrical energy industry entities and consumers of electrical energy, owning, on an ownership basis or other legal basis, electrical energy generation facilities, as well as such general system parameters as installed (nominal) and peaking available capacity in the generation mode (conversion into electrical energy) and electrical energy consumption mode, power-time characteristic, active power ramp rate, active power adjustment range, reactive power control range, willingness to participate in the overall primary frequency control.

In order to further integrate and develop EESS in the electrical energy industry, changes will be required to the regulations of the federal executive authorities: rules for testing and determining system-wide technical parameters and characteristics of generating equipment; requirements for ensuring the reliability of electrical energy systems, reliability and safety of electrical energy facilities and power receiving installations; requirements for the design of normal (temporary normal) electrical connection diagrams of electrical energy facilities and the procedure for their coordination with the dispatch centers of the operational dispatching management system in the electrical energy industry; rules for issuing permits for admission to operation of power receiving installations of electrical energy consumers, electric energy generation facilities, electric grid facilities, heat supply facilities and heat-consuming installations, and other regulations.

Summing up, it should be noted that in the conditions of the transition of energy to a new technological basis, the issues of legal regulation of the EESS participation in the circulation of electrical energy (capacity) and the provision of related services and, in particular, issues related to the legal regime of storage systems and EESS owners deserve further scientific study.

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