Russian power System Operator: advantages and current challenges

Fedor Opadchiy, "System Operator of the United Power System" JSC Deputy Chairman, Administrative Committee member and GO 15 Vice President in 2018 – speaks on peculiarities of the Russian power system and its operation dispatch control, its history and future, as well as on major challenges they face.

– What are the peculiarities of the power system controlled by the Russian system operator?

Russia has the widest territory in the world, so its power system can be characterized as one of a high geographic extent. It consists of seven interconnected power systems, each of them, in its turn, including a significant number of regional power systems. Interconnected powers systems comprise large centers of electric power generation and consumption and are connected with extended main transmission network of 330kV, 500kV and 750 kV voltage types. 750 kV network is concentrated in the central part of the country. It primarily provides power delivery of the nuclear and the largest thermal power stations. The rest of the main transmission network infrastructure operates at 220kV-330kV and 500 kV. 220kV and 110 kV networks operate in the regions delivering power to the largest energy hubs. The existing topology of the backbone network was basically formed in the Soviet times. An important role in the process of operation of such an expanded power system is played by power flows in the main network as well as by system sustainability maintenance.

Historical peak of consumption recorded in our power system amounted to 157.4 GW, annual power consumption in 2017 slightly exceeded 1,000TW/h, and the installed capacity as of 2017 reached almost 240 GW.

Most power stations with capacity exceeding 25 MW and network facilities of 220-750 kV operating in the UPS of Russia serve as the objects of dispatch for the System Operator. 110 kV network facilities are managed by the System Operator only in case they have a systemic effect on regional electric power operation modes. Lower voltage type is represented by distribution networks managed mostly and locally by network companies. The principal part of the distribution network complex enters into PJSC ROSSETI, and alongside this there exist more than two thousand independent network companies.

The United Power System of Russia (UPS of Russia) is a part of a large power pool operating synchronously and including power systems of 12 countries. The UPS of Russia is the largest part of the power pool. It shares about 70% of the total electricity consumption of the synchronous zone. The size, geographic location of the UPS of Russia and network topology place Russia under the duty of frequency regulation in the power pool. The Russian system operator pays fairly much attention to the parallel operation modes coordination both directly during modes management and during development and promotion of normative documents and market regulations.

The UPS of Russia was formed by consecutive consolidation of regional power systems, so the current structure of dispatch control reflects such composition of the power sector. There are three levels of the dispatch control structure: Central dispatching office, 7 interregional dispatching offices and 49 regional dispatching offices. Such hierarchy is, in many ways, motivated by viability reasons of such a large and extended power system. Sharing responsibilities among the dispatching offices of the System Operator allows to provide control in complicated and emergency situations, as well as to deal more thoroughly with the issues of regional power systems development planning being highly important for the UPS of Russia which historically developed in the conditions of shortage of resources and has a significant number of bottlenecks.

– How do the power system peculiarities affect its electric mode operation?

– The Russian power system has good natural capabilities for optimization of modes of generation load, as well as for sustaining reliability.

First, wide capabilities of optimal usage of the existing generating capacities naturally originate from the high geographic extent of the power system due to location of the UPS of Russia synchronous zone within seven time zones. The load peak moves within the power system from the East to the West together with the sun allowing for a more effective usage of the existing power stations. Due to the coincidence of the load peak, when the total peak of the power system is significantly lower than the total of local load peaks in its parts, the requirements for the power system maximum capacity reserves decrease and a tighter time schedules of loading of power stations is achieved with a direct impact on the power generation effectiveness.

To fully use the effect, the System Operator implements procedures of consecutive planning of the system operation modes, which include hourly complete optimization of loading modes for all power stations operating at the wholesale electricity market, and there are about 400 of them. This planning system ensures the highest system effectiveness of fuel consumption by using the most effective generating equipment among that available at the moment considering the actual costs for power transmission. Due to the great geographical extent of the power system, the climate impact differs much in different regions: temperature can be higher than the forecast in some regions, and lower in other, and thus the task of rebalancing of the system operation to a mode close to the real time becomes more urgent.

Secondly, we consider thermal generation, namely gas, as the main method of electric power generation because Russia possesses greatest reserves of the world's gas resources. In Russia it is a relatively cheap fuel type and it is also much more ecology-friendly as compared to coal the reserves of which are significant as well. Thermal generation share in the total generation capacity of UPS is over 68%.

After exploration of gas fields of West Siberia in the central part of the UPS of Russia in 1970s, large generation volumes originally designed for using coal were gradually redesigned for gas.

An important role is played by hydro generation responsible for over 20% of the total capacity of the country's power system. Both thermal and hydro generation are highly flexible resources that give serious advantage for electric power mode operation. Low-flexible nuclear generation covers 11% of the total generation capacity of the UPS of Russia and is concentrated in the western part of the UPS of Russia up to the Urals.

An important feature of the UPS of Russia is a large share of thermal power stations with combined generation of electricity and thermal power, this being explained by the climate factors specific for Russia. Most of our cities and towns use systems of centralized heat and water supply, due to the fact that the most effective method of fossil fuel combustion is combined cycle

operation with the theoretically possible efficiency approaching 100%. Thus, simultaneous introduction of heat supply and electric power generation allows for significant reduction of fuel costs. However, this imposes additional limitations on load maneuvers at such stations (primarily, on unloading below the value specified), because heat generation modes are of top priority in accordance with the federal laws. To some extent, the volumes of electric power generation in the cogeneration mode are considered by us as an analogue to the influence on the RES balance considering the difficulties of operating generating facilities based on RES due to instability of the latter. This cannot be a complete analogue, though, as the cogeneration modes are much more predictable than the RES, and there are alternative methods of heat generation; still in general, generation in the cogeneration modes is considered by us to be one of the main "consumers" of a power system flexibility in winter time. And it undoubtedly has a significant effect on all dispatch control procedures.

Third, some market instruments are used to support adequacy and stability. Primarily, it is the capacity market that stimulates generating companies to maintain the power objects in a proper operational state. Ancillary services market was formed several years ago to solve the issues of formation of necessary reserves of rated primary and automated secondary frequency control. It adds to the capacity market mechanisms creating resources needed to support reliability and operational quality of the power system. Economic mechanisms are also built in the structures of the day-ahead and balancing markets and aimed at more accurate compliance of power stations with time schedules and instructions of a dispatch control engineer.

The market rules are not static, so they regularly require to be finely adjusted to the changing environment which includes new technologies appearing, changes in the macroeconomic situation etc. The System Operator is deeply involved in the procedures of design and promotion of normative documents and their modifications. The task is to keep balance between technical aspects of functioning of such a complex object of engineering as a power system, and economic innovations.

– Nowadays, a number of the world's largest power systems undergo processes of unbundling the functions of power system dispatching from the network operators structure and a transfer to the independent system operator model. Each country has its own reasons to do this. What were the reasons for Russia to choose the independent system operator model?

– The independent status of the System Operator in Russia came as a natural result of the influence of a series of economic conditions and technical particularities of the power system. In Russia the concept of the independent operational dispatch control was developed at the beginning of 2000s during preparation of the sectoral reform, in the course of which the power complex was unbundled as per activity types: generation, transmission, supply, scientific research and engineering and etc., and further competitive types of business were privatized. Under such circumstances, in order to ensure technological integrity of operation of such a large and extended power system as well as provide for the possibility of systemic optimization of its operation, which I described before, it was required to structurally incorporate within one company the functions of operational dispatch control of the UPS of Russia at large as well as of the interconnected power systems and the regional power systems which were formerly under control of vertically integrated regional holding companies.

Besides, in the circumstances of unbundling of the electric power industry by the activity types and competitive businesses privatization, nearly every technological action of the System Operator influence economic results of certain market players' activities; and the scale and the scope of such influence increases dramatically upon rise of the level of centralization of

operational dispatch control functions. The simplest example – coordination of repair schedules of the electric network and generating equipment. In our power system having a significant number of bottlenecks, it is often impossible to conduct all necessary works with the equipment owned by different owners, so their mutual coordination is required. It becomes critical during fulfillment of such function to avoid the conflict of interests and affiliation of the System Operator with any of the market members.

Another example. Modern power markets aim at optimizing the cost of power for consumers. With that it often happens that loading a cheaper power station, located remotely from the consumer, proves to be more effective than loading of an expensive one which is nearby, despite the fact that this leads to increased network losses. This is an advantage for the consumer who pays for the whole chain – generation plus transmission; but for a network company this means direct rise of costs related to compensation of additional losses. In case the System Operator enters a network company a new conflict of interests arises. By the way, we conducted special simulation together with the Trade System Administrator (electric power exchange) to learn what would happen if the wholesale market was restructured for the purpose of network losses optimization, and the results we got were catastrophic for the consumer meaning the price increase by 2 or 3 times provided that the current principles of price formation were preserved at the wholesale market. This means that the independence of the system operator is an important condition for the current organizational model of market relations within the Russian electric power sector to exist.

The System Operator is deeply involved in the processes of technological connection of new consumers and power stations to the network. According to the laws applicable in Russia, all technical specifications issued by network organizations for connection of generation and consumers with a capacity of more than 5 MW are mandatorily to be approved by the System Operator. In this process we act as an independent technical expert and this helps us to balance the problems of maintaining the power system reliability and economic results of specific technical solutions of different sectoral subjects. The independent status of the System Operator makes it possible to avoid the conflict of interests within this process as well as to ensure transparency of the suggested solutions for all participants of the process.

There are many other examples of potential conflicts of interests between the functions and the ownership structure of the System Operator. Just because of this, the variant of a completely independent system operator with 100% control over it being retained by the government was chosen while reforming of Russian electric power sector.

– What are the main challenges that your company is facing now? How do you manage them? What kind of problems does this help to reveal?

– As it is today, the System Operator has been existing for over 15 years. During this period, Russian electric power sector has overcome several serious challenges relating directly to the company's functions.

Thus, in middle 2000s, there was a forecast for the soonest shortage of generating capacity and power system networks capacity associated with the rapid growth of the Russian economy after the economy collapse in 1990s due to the demise of the USSR. For example, restrictions on electric power consumption were introduced even in Moscow during peak loads in autumn/winter, 2005-2006.

To solve this problem, the decisions were adopted on the government level aimed at stimulating investments in construction of generation facilities and network infrastructure

development. Particularly, for generation development, the program of agreements for capacity supply to the wholesale market was developed and implemented stipulating signing of agreements with investors for capacity supply to the wholesale market. This is a program of facilitating investments in construction of new generation facilities within the time limits previously agreed upon, with the specified location and technical parameters as well as with the payback to be received by the investors within 10–15 years after commissioning the project. Generation facilities around 30 GW were realized or upgraded under the above CSA (capacity supply agreements) program. Now it is at its final stage, the last generating unit under CSA program is scheduled for commissioning in 2019.

One of the most serious challenges for the System Operator was launch of electric power, capacity and ancillary service markets; they were gradually introduced in 2003–2015.

The System operator ensures functioning of the technological infrastructure of the first two markets. To fulfill the task, the company had to drastically upgrade its computer facilities and hardware-software complex; review the principles of operational and long-term planning of electric power modes; develop mathematical model of the UPS of Russia for markets functioning; create from scratch the formalized system of generating equipment unit commitment for several days ahead. As for ancillary services market, the System Operator is committed to ensure its functioning, starting from service providers selection to services quality control and their payment.

Not all the forecasts considered at reforming of Russian electric power sector worked well. At present we have faced a significant slowdown in electric power consumption growth (demand stagnation); it made less than 1% in 2017 whereas the forecast value of annual increase of electric power consumption was stated to be about 4-5%. As a result, today, instead of shortage, we have about 15% of generating capacity in excess of the needed volume with due account for reserves. Such change of the balance resulted in significant growth of competition among suppliers, and consequently, noticeable decrease of the relative cost of electric power on the free market. Rates of electric power prices growth on the wholesale market lag behind those of the prices for the basic type of fuel used, i.e. gas. All these reduce investment attractiveness of the sector and set forward a number of fundamentally new tasks.

The basis of the generating facilities in the UPS of Russia is formed by the power stations built in 1970s. Taking into account completion of the CSA program according to which new equipment was put into operation, now the current task is to develop and implement mechanisms facilitating modernization and prolongation of the life-cycle of the existing generating capacities. As of today, over 40 GW of thermal power stations require replacement of turbines that have exhausted their fleet life. Other large-scale equipment of power stations also needs to be replaced.

In order to implement such major plans special mechanisms require to be established in the sector to ensure massive implementation of such type of projects. Nevertheless, simultaneous decommissioning of equipment for reconstruction at different power stations must not cause problems of temporary capacity shortages in the power system, as a whole and in some of its parts, in particular. Reconstruction is reasonable to be applied, first of all, to the most relevant equipment, this means that regular modes of operation will also be changed in the course of the program implementation. In order to correctly and properly consider all technical aspects of the massive modernization, currently the System Operator takes an active part in the process of development of applicable rules and procedures. Quite recently, together with the Trade System Administrator, we have held test tender for the purpose of modernization projects selection, and

we got about 400 bids from various power stations. This makes it possible for us to evaluate approximate parameters of the modernization program and the projects structures even today.

The second acute problem is related to the previous one and consists in setting up a process of decommissioning of outdated and non-effective capacities that cannot be reasonably upgraded due to technological or economical factors. This issue is quite complicated as a significant part of the operating thermal generation ensures district heating of cities, towns and settlements, thus, even power stations that are unprofitable cannot be closed without any substitution, this being very often related to serious investments. The similar problems arise if certain generating units affect stability of local electric modes due to the locations of the units in the network; substitutional actions are required at decommissioning of such units, and sometimes even commissioning of new generating capacities may be needed. Solving of such matters requires a separate code of rules and procedures to be set, this is what we are actively engaged in today.

There are also other important issues set forth by today's world. It is, for example, development of the common electric market with Kazakhstan, Belarus, Armenia and Kirgizia. This project is very interesting in all terms – technological, political, legal and organizational. Despite the fact that all our countries used to comprise the USSR and formed a unified state, there was not any unified policy considering rules of operation of power systems in different countries in the last years, thus, over more than 20 years, each state has formed its own specific structure of power sector management. In Belarus, there is for example, a vertically integrated power company and a tariff regulation; in Kazakhstan there is the monthly sales volumes market model. We assume that in Russia today one of the most advanced market models is used with respect to the experience of power markets functioning in many states of the world. So, now we face an ambitious task of building up a common energy market that will enable optimization of balancing of several countries' power systems. I think, it will be quite difficult to synchronize different models of power systems which vary so much. But still we believe that we will be a success in everything; this assumption is supported by the positive experience that we have had in synchronizing Russian market and Nord Pool (nowadays it is part of the European Internal power Market) during the power exchange with Finland.

Speaking about internal challenges, three main directions can be determined. First of all, we are now executing a large project of implementation of a new-age operative-information complex (SCADA) in all of our 57 system control centers. The life cycle of the current solution is being finished, and we are in the process of designing of the new SCADA-system, as well as of phased implementation of its key blocks, such as the hierarchical manager of network models, calculated subsystems etc. The task is even more complicated due to the fact that, given the existing three-level structure of operating dispatch control, all our key IT-systems require a distributed structure on the one hand, and, on the other hand, it is critical for us to ensure not only data integrity and consistency in all system control centers at the same time, but also the possibility of autonomous operation of each of them in emergency situations. This task is very complicated and interesting with regard to IT. We consider very important and useful our GO15 colleagues' experience and results of GO15 committee 4 "Grid Intelligence" research as well as such documents as White Paper "EMS for the 21st Century System Requirements" by CIGRE in 2011 for the designing process and practical work. . . All these enable us to consider most advanced global achievements during new SCADA-system development.

Second, we actively develop both new automation tools based on WAMS (Wide Area Measurements System) technologies and emergency automatics. The research conducted within GO15 committee 4 demonstrated that, as of 2015, the UPS of Russia ranked third in terms of the

quantity of the mounted phasor measurement units (PMU). Within the framework of our technical policy, we implement a complex program of development of automation technologies based on phasor measurements.

And third, we implement projects focused on operating-dispatch control organizational framework improvement. We integrate operational zones of regional control centers and pass control of a smaller regional power system where there are no big generating facilities or consumer centers to a neighboring larger control center. So instead of a fully functional control center, a small representative office remains in such region which is responsible for communication with local authorities on a number of issues, such as power system development planning. Such projects are implemented not only to optimize expenses, though this is important, but to improve the power system control by development of new technologies and strengthening of the personnel in the remaining system control centers . Such projects are quite complicated in terms of technology, as they require restructuring of the existing communication network and the IT-infrastructure, as well as training of staff. In such a way, we consolidated 16 system control centers over the last years.

– What tasks System Operator is facing today in the field of normative regulation in power sector ? What do you do to solve them?

– This is another challenge among those that Russian electric power sector is facing today. At present, a basis for a new normative and technical regulatory system for the sector is being formed. The matter is that after reforming, the electric power sector lost a significant part of normative documents regulating, above all, the issues of the power system reliability. The majority of the documents comprised technical and other compulsory requirements to equipment and organization of processes developed as back as in the Soviet times. After the demise of the USSR, validity periods of these documents were prolonged in the beginning of 1990s, but as a result of reforming, which led to a fundamental change in the economic bases of the sector, the documents became non-applicable. While preparing the reforms, many thought that the issues previously regulated by the documents then would be regulated by the market. But that did not happen.

Unfortunately, such approach to the issues of normative and technical regulations taking place during the reforming process led to a normative gap, and it is only now that we are bridging it. The United Power System" managed to survive through the "legal vacuum" period thanks to the margin of safety, set at its establishment, as well certain technological traditions on which Russian electric power sector was always based. However, the margin turned out to be limited. Given the absence of a normative base, the owners of power facilities got a formal possibility to economize, even by means of neglecting the order which had been set over decades and which ensured existence and stable functioning of the UPS of Russia. The electric power entities, having become independent market companies, started to adopt their own technical policies which often collided with each other because of the absence of a general normative basis in the sector. Lack of coordination in technical solutions adopted at differently owned objects more and more often led to commissioning of equipment and devices that could not function cooperatively in the framework of the UPS of Russia due to differences in their parameters. Over these years, a certain quantity of equipment has been introduced into the power system with technical parameters and settings that do not meet the criteria of functional stability support.

"System Operator of the United Power System" — an organization providing technological basis for the electric power sector functioning — was one of the first to recognize

the problem trying to persuade the state and the sector authorities of the necessity to build up a system of unified compulsory technical regulations and requirements.

Now the system of normative and technical regulation is starting to take shape. It includes three regulatory aspects.

The first aspect is – normative and legal regulation of the governmental and the ministerial level based on the Federal Law on Power Industry, documents of the ministerial level and documents established by ministries and departments. This part represents regulation of the highest level of technological activity: cooperation of the sector entities, functioning and development of power systems, principles of the power objects equipment operation, personnel training. This scope also includes normative requirements to reliability of electric power systems and objects ensuring their technological compatibility and effective co-functioning within the UPS of Russia.

The second aspect – technical regulation. It is based on the Federal Law on Technical Regulation, international agreements in the framework of the Eurasian Economic Union and technical regulations. This part of the system is aimed at ensuring product safety and allows solving issues related to setting up requirements to the generating equipment as to a product.

The third aspect – standardization based on the Federal Law on Standardization, and implementing national standards and those of the electric power entities as instruments. Both provide significant support to the whole system of normative and technical regulation of the sector specifying details and taking into consideration various technological peculiarities.

– How is the problem of the power system development planning being solved in the UPS of Russia ?

– The System Operator takes part in a large number of mechanisms of the power system long-term development , starting with consideration of applications for technological connection to electricity networks and conducting long-term competitive capacity auctions and ending with working out a 7-year pattern and a program of “the the UPS of Russia development which is annually approved and confirmed by the Ministry of Energy of the Russian Federation.

Recently we have launched a new mechanism of finding solutions to problems of local shortages of generating capacities which eventually arise in certain energy hubs despite the general capacity surplus. The mechanism is based on the same principles as the capacity market: an investor is chosen for a new generation on a competitive basis, and, under the condition of commissioning of a certain capacity with the given characteristics and within the terms specified, for several years such investor will be granted a guarantee of loading of the generating facilities and a specified payment for the capacity. As of today, we already have two new power stations being built according to this mechanism.

– For the last years the traditional state of the power sector was being changed under the influence of new technologies: distribution of RES, distributed generation, power electronics, “SmartGrid”. How does the power system dispatch control mechanism react to these changes in your country?

– In Russia, a governmentally approved development program of wind and sun generation has been established for several years already. Project selection and earning income by the RES owners are in accordance with the principles well-proven on the capacity market. Development of such generation is, just like in many other countries, subsidized on the account of other market participants. Tenders for building a certain volume of the RES are held annually. As of today, 234 MW of solar generation have been commissioned; last year the first large wind farm with the

capacity of 35 MW was put into operation. Localization of the corresponding equipment production on the Russian territory is an important requirement to these projects. All new projects that are annually submitted for tender contain requirements for a deeper localization of the equipment production facilities. Considering insignificant RES volumes, their commissioning has not yet had any effect on the principles and the major procedures of the Russian power system control. Nevertheless, the System Operator takes an active part in the process of setting up a normative and technological basis for RES functioning within " the UPS of Russia, and also works on determination of technical standards for interaction with such power stations. Requirement to the generating facilities' staff, their observability at the dispatch control centers etc. are specified. According to the rules, right away such facilities are obliged to ensure readiness for operative disconnection from the network upon a dispatcher command. We assume that it is necessary to follow the route of extended requirements to RES participation in the processes of the power system control. For example, in frequency control.

This, to the full extent, also concerns distributed generation. Under Russian conditions, these are mostly small thermal power stations using gas-fueled generating technology, or small gas turbines. Such stations are constructed by the end users to whom savings on the network tariff are significant. They can also be used by plants that have got gas as a by-product that must be disposed of in accordance with ecological requirements after all. In a number of cases application of such solutions helps the consumer to economize significantly, particularly in cases when a new facility is connected to a system. Today this process develops dynamically, so it is very important to determine the unified rules that will not do any harm to other players.

Development of consumers' generation caused new challenges: how should a consumer being an owner of generating facility interact with the power system; should the "big" power system consider this facility as a reserve, and if yes, then what volume of generation ; what should be his economic relations with the UPS of Russia; and others. One of the solutions set up and promoted by us, as far as distributed generation is concerned, is the concept of a self-balancing utility company (SBUC). In its essence, it is a micro power system – a mini-VIC (vertically integrated company) which combines all: consumption, generation and transmission. The basic idea lies in the limited connection of such "cell" to the "big" power system fixing relations with the "cell" strictly within the scope of such connection with full liberalization of internal relations between the entities. To our mind, such model could be suitable for economic clusters – industrial and business parks. At present the model is considered as a pilot model.

– Does your power system use any economical demand response technologies? What do you think of their potential? If not used, do you plan to introduce any?

– Yes, they are certainly used. This mechanism was developed and started working last year. Starting from January, 1, 2017, this new mechanism has been included in the day-ahead market procedures. We use it to extend participation of our consumers in the procedures ensuring the market balance between demand and supply, as well as to increase competition. Today several large industrial consumers, particularly, aluminum plants, participate in the programs of economical demand response on the wholesale market. At present Demand Response rules are at the stage of development for the retail market.

– "**Power System Of The Future" term is becoming more and more popular in the global power field. What does this notion mean for you?**

– The notion of the "power system of the future" does not seem to have only one meaning to me. Of course, there is a constituent which is common to all of us. It includes, for example, the

endeavor to increase power system energy efficiency and get maximum possibilities not out of extensive growth, but by implementation of innovative technologies.

Extensive development is becoming more and more expensive – it is impossible already to extend networks in many countries due to the lack of land. This means that, on the one hand, the share of distributed generation will grow, and on the other hand, that it is necessary to make the maximum use of the possibilities offered by the existing infrastructure. And this is then the so-called "smartisation" – flexible transmission systems, power electronics, improvement of monitoring and control systems. For example, here, in Russia, we develop systems for monitoring of reliability margins of the transmission network with potential implementation of WAMS technologies, based on the same principles as the unique Russian centralized automated emergency control systems. The monitoring systems enable to optimize to use available transmission capacity of interconnections by harmonizing interconnection working mode with current operational mode of the power system.

An important constituent of the "power system of the future" notion – application of Demand Response technologies. This also helps to improve the power system output. For example, at present in the UPS of Russia there are about 2 GW demanded less than 44 hours a year. Just as any other generators, these facilities participate in the capacity market and their capacity is paid for all the year round. Instead, it is possible to pay a relatively small sum for the consumers to decrease consumption within these 44 hours a year. This is more effective from the point of view of the power system economy.

Voltage types will also grow, as this helps to increase the networks transmission capacity without creating new corridors for the interconnections; generation will move closer to the centers of consumption, or vice versa, to the places concentrating primary resources, particularly speaking of the RES; direct current transmission lines and power electronic devices must develop.

I presume that in the "power system of the future" we will also find a solution to the issues of electric power storage, but it should not be only by means of a universal breakthrough innovation. Each country can solve the matter in its own way, depending on the possibilities and natural advantages that it has. Somewhere there can be power storage hubs made up of an enormous number of small-capacity batteries. Traditional pump-storage plants will continue to be developed, and somewhere new solutions will be set up and introduced, such as gravity power storages. In any case, the power system will obtain new qualitative features only when it has got many power storages and all of them are integrated by sole control systems.