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«Smart Grid» Concept As A Modern Technology For The Power Industry Development

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Abstract. The article discusses the main problems of the power industry and energy supply to the distribution networks. One of the suggested solutions for these problems is the use of intelligent energy networks on the basis of digital reality simulation, in particular, the concept of «SMART GRID». The article presents the basic points of the concept and the peculiarities of its application at the enterprises. It was demonstrated that the use of this technology eliminates power shortage, reduces the energy intensity and improves the energy efficiency throughout the operation of an enterprise as a whole.

1. Introduction

The burning issue of today is creating integrated intelligent energy networks (IEN) based on the digital reality simulation (Virtual reality systems). In the western countries, this approach became the basis of formation of a new energy management technology named as the «Smart Grid» concept [1].

«Smart Grids» are electrical networks that meet the future requirements for energy-efficient and economical operation of the power system through the coordinated management and using modern two-way communications between the elements of the electrical networks, power plants, accumulating sources and the consumers [2] (fig. 1).

The greatest expectations of Smart Grid technology applications are related to the degree of consumer participation and the level of utilizing the productive assets of the distribution networks.

In the area of consumption, the characteristic feature is the reduction of the peak loads and, as a consequence, shifting the construction of the new power plants. Saving up comes up to $ 18 million per year. In the distribution networks, the losses are reduced up to 10%, CO2 emission is reduced by 45 tons with the saving of $ 7 million per year [1].

In the field of generation, the main effect is reducing the number of accidents and unscheduled repairs. The savings are $ 11 million per year and the accidents are reduced by 80%. Implementing an intelligent network technology pays off in 4 years [3, 4].

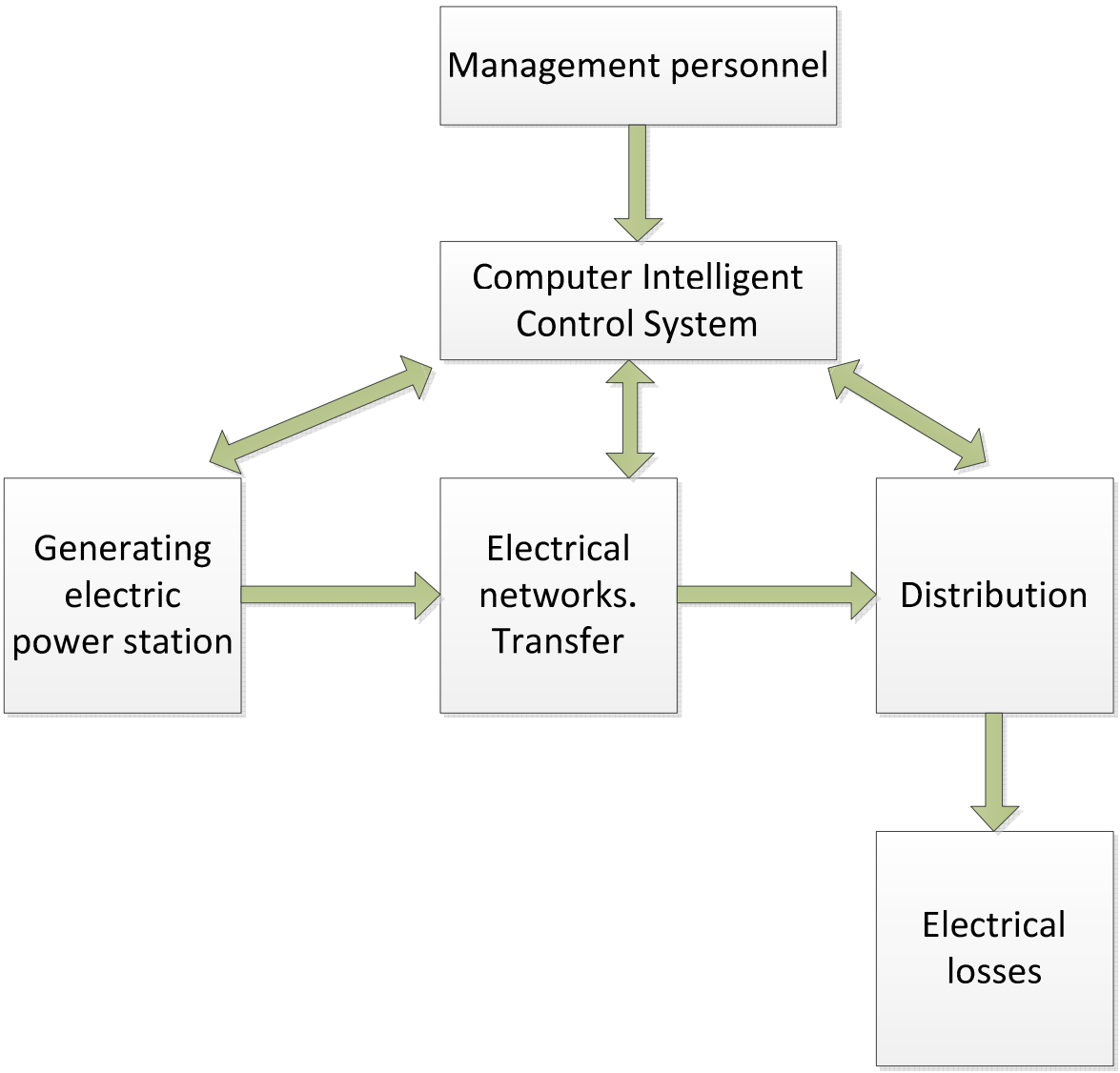

Figure 1. Organization of intelligent energy networks (system «Smart Grid»)

2. Methodology

The important point improving the reliability of the network equipment and its efficiency, as well as extending the service life of the power equipment. The savings from extending the service life of the equipment are $ 5 million per year. Introduction of the intellectual network technologies significantly reduces the number of accidents and time for the recovery time of the damaged equipment [5].

The existing power grid in the area of electricity generation is oriented towards the priority of large generation (hydro power plants, thermal power plants etc.) with the implemented active management by the preset modes of generation [6]. In case of switching to an intellectual system, any generation is used including renewable energy sources (for example, wind power etc). It is active management of all the generating capacities and creating the management centers for the overall coordination. Using different kinds of generating the electricity - from large scale to small energetics – helps to eliminate the power shortage.

3. Discussion of Results

The current energy system realizes a passive transmission system of power transmission; the system is managed by switching actions. As a rule, the functions of observability and controllability of the

electrical networks are underperformed. In case of switching to an intelligent system, an intellectual electric transmission system with power management modes in real time is provided with the observability function and manageability functions provided for the electrical networks.
In the current energy system, the free use of electricity by the consumers is realized taking into account the external constraints (eg, electrical power, etc.). Switching to an intellectual system provides a flexible efficient use of electric energy adapted to the various system situations.

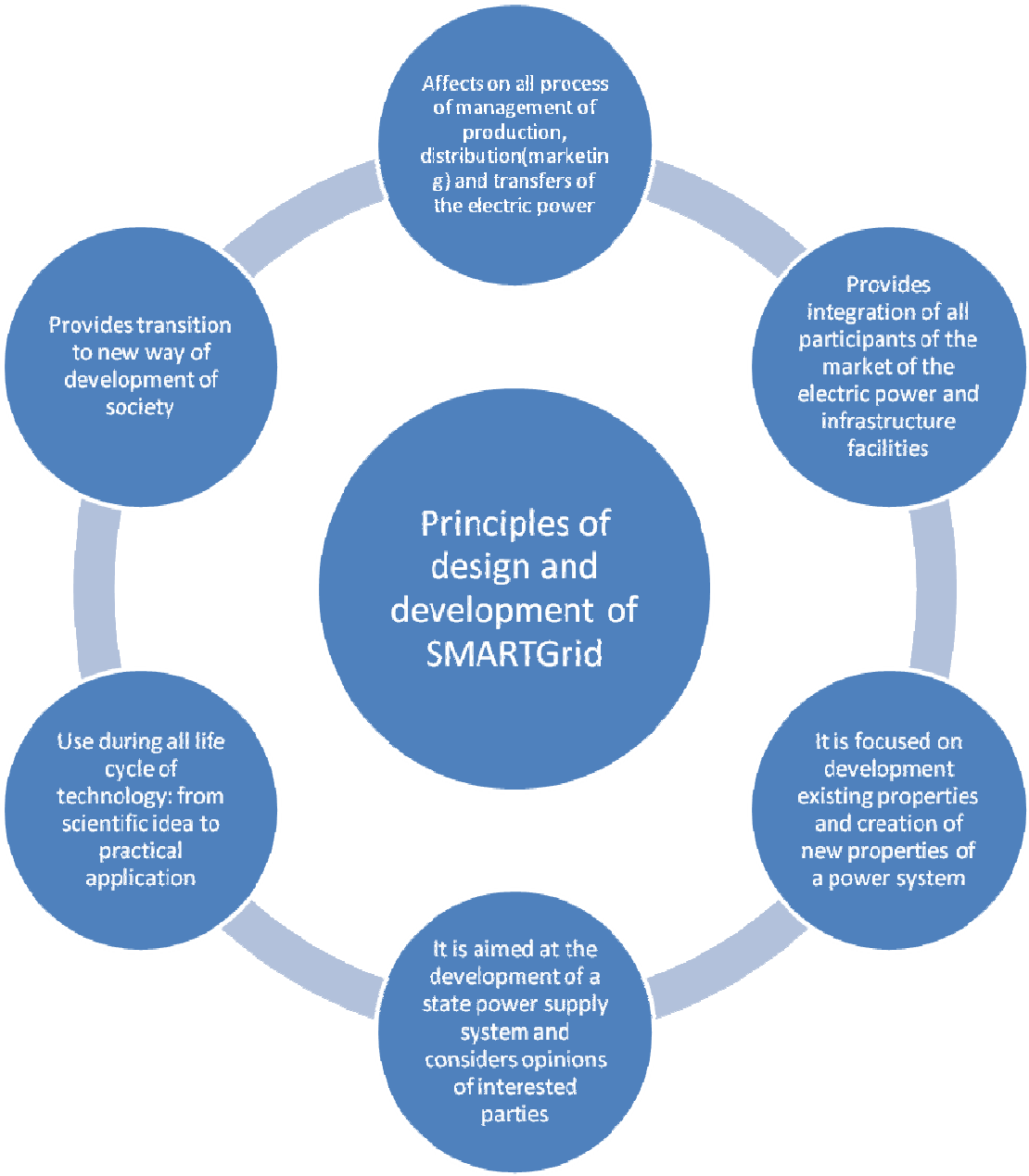

Figure 2. Principles of design and development of SMARTGrid.

The analysis carried out in [4] has allowed us to formulate the following assumptions adopted abroad for the design and development of the Smart Grid concept (fig. 2):
1. The Smart Grid concept implies the system conversion of the electrical energy system (grid) and affects all its basic elements: generation, transmission and distribution (including the sphere of utilities), marketing and dispatching control.

2. The energy system is considered in the future as an infrastructure similar to the Internet for supporting the energy, information, economic and financial relations between the parties of the energy market and other interested parties.
3. The development of electrical energy industry should be directed to the development of existing and creating new functional properties of the power system and its components providing the achievement of the core values of the new electrical energy industry developed as a result of a shared vision of the objectives and ways of its development by all the stakeholders.
4. An electric network (all of its elements) is considered as the main object of forming a new technological basis enabling a significant improvement of the existing and the creation of new functional properties of the grid.
5. A more successful realization of the Concept of the Smart Grid takes place only in case all the prerequisites are created for it in the home market, i.e. there are the required technologies in the field of cable industry (for instance, those that were cited in the articles of authors [6] and [7]), automation, data support and other elements of the energy system, oriented towards the local conditions, as well as the availability of the demand for these technologies at the consuming end.
6. The development of the concept, which encompasses all the major areas of development as a complex from research to practical application and replication, which should be performed at the scientific, legal, technological, technical, organizational, managerial and information levels.
7. Implementation of the concept is innovative in its nature and gives rise to the transition to the new technological order in electrical energy industry and the economy in general. That is, the energy system can become a basis of development for other branches of industry by means of application of new technologies in logistics support, data support of functioning of this system. This allows generating demand in the home market for innovation in this field and creating the conditions for raising underdeveloped branches of industry to a new level of development.

4. Conclusion

Summarizing, we would like to note that Russian companies need to pay close attention to the concept of «Smart Grid» as its application creates effective motives for the increased control over the energy resources, streamlining their management, reducing the energy consumption and improving the efficiency of the overall activity of the enterprise.

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