

Technological aspects of modelling and research of smart grid

I.Kh.Siddikov

Professor, Doctor of Science, Head of the Department of "Power supply systems" TUIT named after Muhammad al-Khwarizmi
Tashkent, Uzbekistan
ikhsiddikov@mail.ru

M.A.Anarbaev

Head of the Department of "Power systems" Djizak Polytechnic Institute, Djizak, Uzbekistan
anarboev72@mail.ru

A.A.Abdumalikov

Assistant-teacher of the Department of "Power supply systems" TUIT named after Muhammad al-Khwarizmi
Tashkent, Uzbekistan
akmalabdumalikov6@gmail.com

M.A.Sobirov

Assistant-teacher of the Department of "Power supply systems" TUIT named after Muhammad al-Khwarizmi
Tashkent, Uzbekistan
muzaffar-sobirov@mail.ru

M.T.Maxsudov

Department of "Electrotechnic, electromechanica, electro technologies" Andijan Mashinobuilding Institute, Andijan, Uzbekistan
mohirbek2702@mail.ru

I.M.Xonturaev

Senior Teacher of the Department of "Power systems" Djizak Polytechnic Institute, Djizak, Uzbekistan
khonturaev75@mail.ru

Abstract-In this paper design of communicational devices and approbation of Smart Grid technologies are considered. As well the characteristics of the functional properties of Smart Grid technology are presented. Model of the power system in complex program MATLAB are developed.

Index Terms - SmartGrid, MATLAB, devices, Microprocessor, network.

I. INTRODUCTION

Energy supply systems on the modern aspect of the development of engineering and technology are considered as the Internet, an infrastructure designed to support energy, information, economic and financial relationships between all entities involved in the production, transportation and consumption of all types of energy.

The main tasks in the modernization of energy supply networks should be the use of modern technologies in the creation of new sources of capacity, the widespread introduction of renewable energy sources and information-measuring and communication systems and devices. The models, technologies and devices of the Smart Grid system studied in this work serve as basic scientific and practical materials for increasing the efficiency of energy use.

II. STATEMENT OF A PROBLEM

In general, the Smart Grid concept implies the widespread use of devices, digital technologies and communication networks to collect and process production and consumption data in order to increase the efficiency and reliability of energy supply. These are not only technological changes, but also fundamental ones: decentralization of the system, blurring of the separation between energy consumption and production, a new approach to

energy consumption, requiring the following characteristics [1]:

- ability to manage the work of energy consumers;
- self-recovery after abnormal conditions;
- security from physical and cybernetic external interference;
- ensuring energy supply of the required quality;
- synchronous operation of energy storage sources and centers;
- the ability to significantly increase the efficiency of the energy system as a whole.

III. MAIN PART

Smart energy supply is a modern and modernized energy supply that uses informational and communicational networks, devices and technologies to collect information on energy production and consumption, which can automatically increase efficiency, reliability, economical benefits, as well as the sustainability of energy production and distribution. The "Intelligent Energy Supply Network" is a one-piece automated mechanism uniting energy producers, networks and consumers. This mechanism is controlled centrally - through a computer center, which receives information about the level of energy consumption from millions of digital controllers in real time. Specialized software helps to track the operation of all participants in the process of generation, transmission and consumption of electricity. To increase energy efficiency, it is necessary to take a course on the use of renewable energy sources. And especially the Smart Grid system is the benchmark for increasing the efficiency of energy use. Special primary measuring devices transform information on the production and consumption of electricity, which allows you to correctly distribute energy resources, to ensure the reliability of their consumption and efficiency of use [2].

Smart Grid involves combining a security system with information-measuring functions.

Microprocessor devices based on protection measure currents and voltage in vector form, accumulate data on trips and emergency conditions in special memory blocks. Thus, the protection turns into a kind of information processing center, an element of the diagnostic system and monitoring of power equipment [3-5].

As you can see, the construction of smart grids named “Smart Grid” in the energy sector is perspective and demanding. Today; this is a natural

stage in the development of the global economy and social relations. In practice, the authors of this work are actively working on the development and design of info communicational devices and approbation of Smart Grid technologies; the prospects for their development which can be formulated in a larger way by a histogram as shown in fig.1:

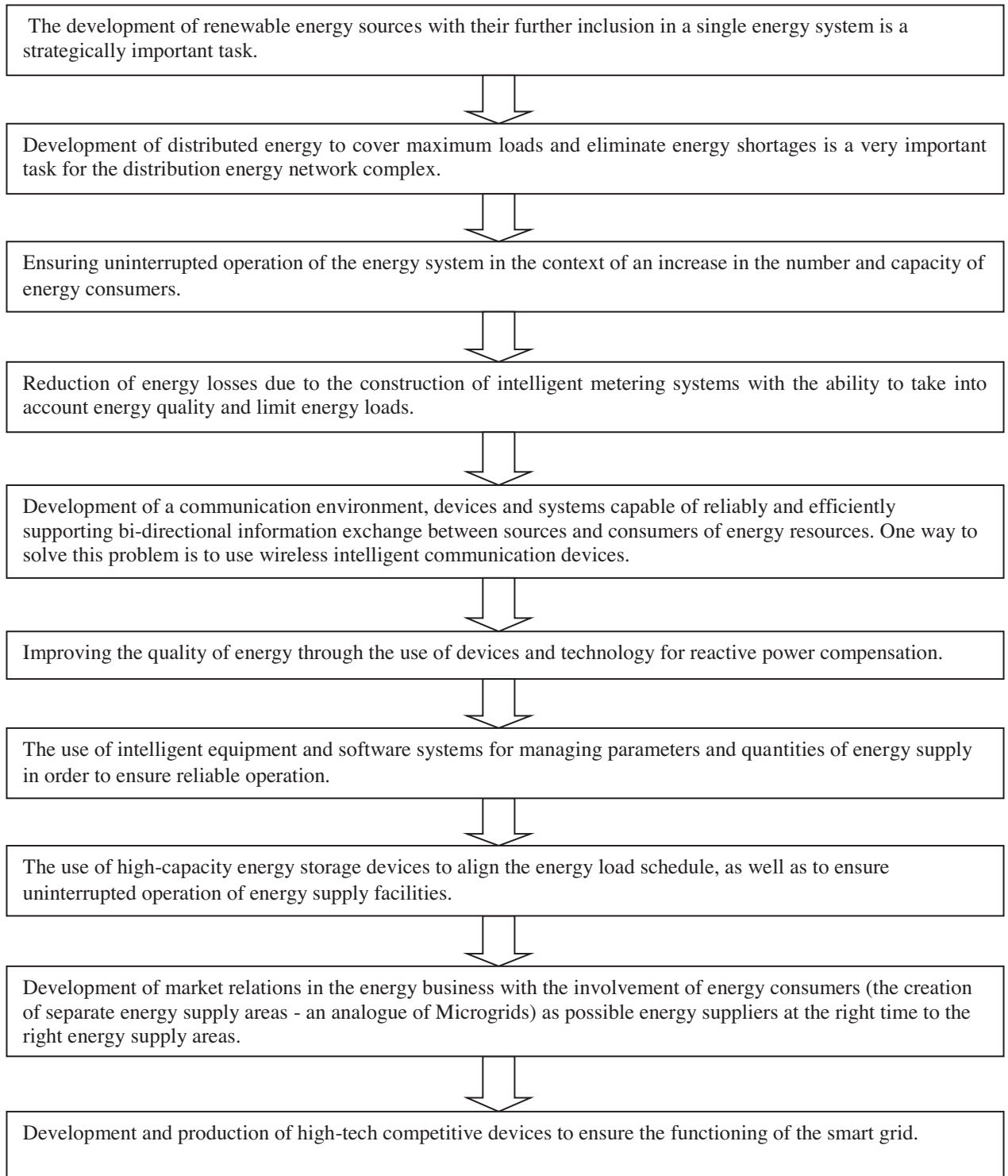


Fig.1. Development and design of communicational devices and approbation of Smart Grid technologies

The listed aspects of the future intellectual energy network clearly correspond to the modernization scenario of energy supply

development. As part of this study, the key requirements for the developed Smart Grid system are formulated in tab.1.:

Key requirements

Tab. 1.

providing consumers with energy without restrictions, depending on when and where they need it, and depending on the amount paid	Availability
the ability to withstand physical and informational negative influences without total outages or high costs of restoration work, the fastest recovery (self-	Reliability
optimization of tariffs for electric energy for consumers and reduction of system-wide costs	Profitability
maximizing the efficiency of use of all types of resources, technologies and equipment in the production, transmission, distribution and	Efficiency
interaction with the environment - the maximum possible reduction in negative environmental impacts	Organic
prevention of situations in the electric power industry that are dangerous for people and the environment	Security

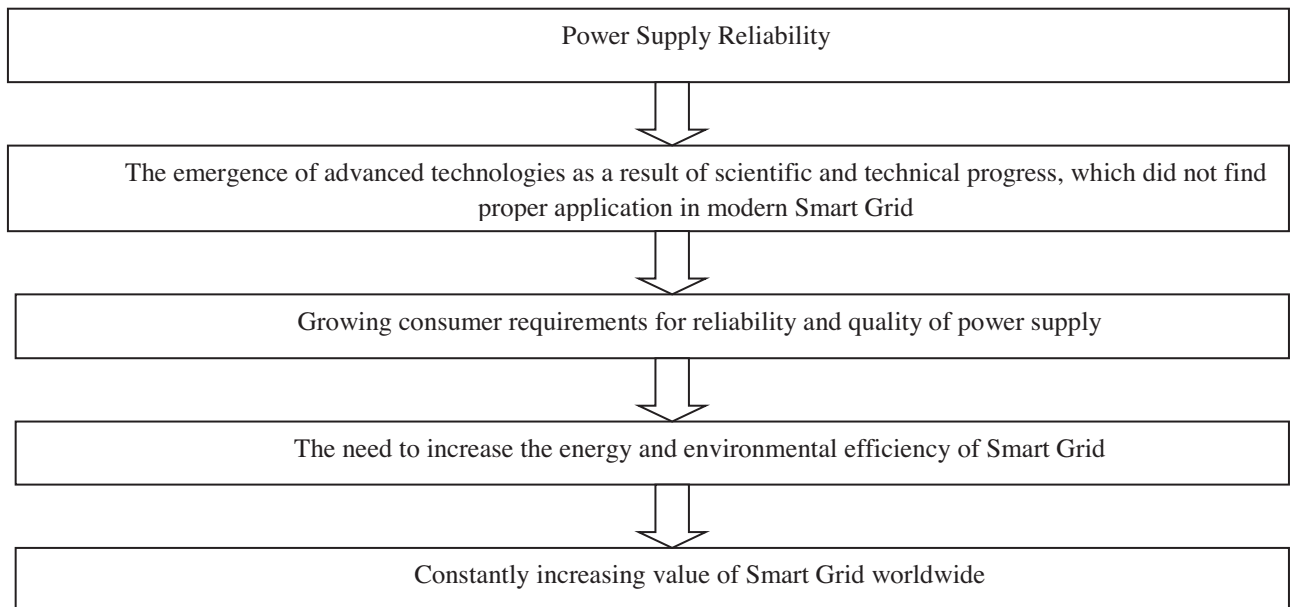


Fig. 2 The main factors of determining the development of Smart Grid.

The Characteristics of the functional properties of Smart Grid Technology are formulated in tab.2.

Tab. 2.

Existing energy supply system	Smart Grid-based energy supply system
One-way communication between elements or its absence	Two way communication
Centralized Generation - Complex Integrated Distributed Generation	Distributed generation
The topology is predominantly radial	Mostly network
Accident response	Accident Prevention Response
Work equipment to failure	Monitoring and self-diagnosis, prolonging the "life" of equipment
Manual recovery	Auto Recovery - Self-healing Networks
System crash susceptibility	Systemic accident prevention
Manual and fixed network allocation	Adaptive highlighting
On-site inspection of equipment	Remote equipment monitoring
Limited power flow control	Power Flow Management
Inaccessible or very late price information for the consumer	Real time price

The results of modeling and research parameters combined control system of sources of reactive power of Smart Grid on base of the complex of the programs MATLAB is presented in fig. 3 and

4. The model of control of source of reactive power was determined that designed model in real scale of time allows to define the parameters and values element of Smart Grid energy system.

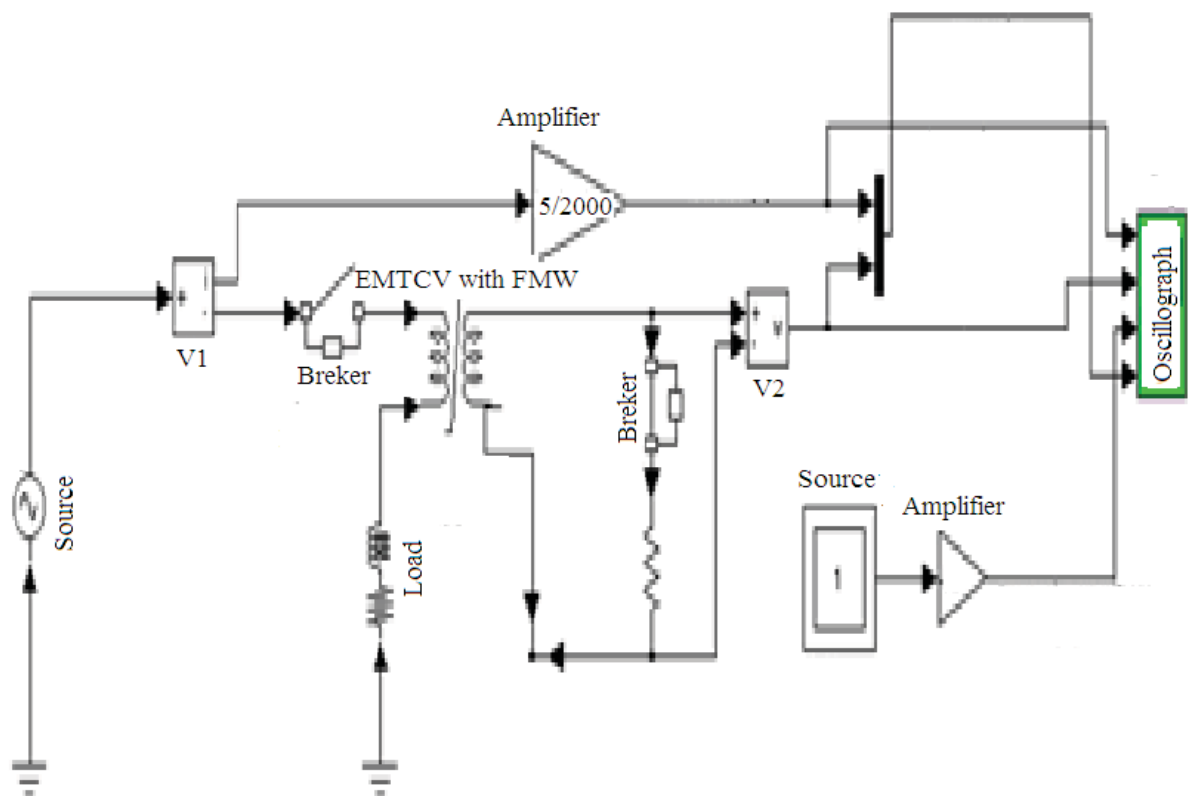


Fig. 3. Model of the research part of power system in complex program MATLAB

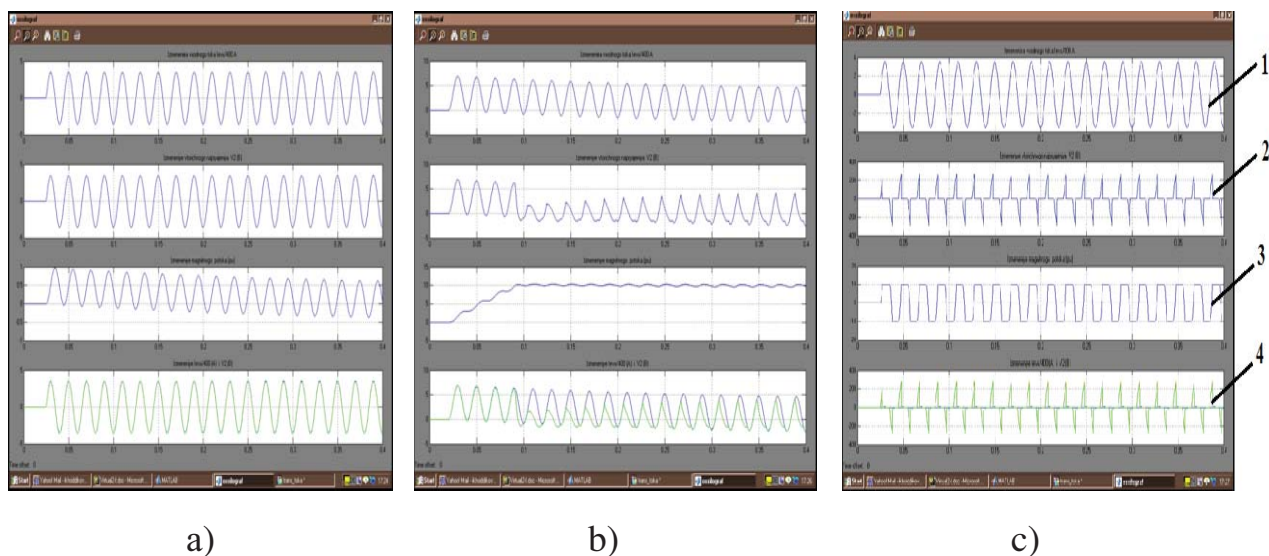


Fig.4. Graphics of input (1 - a primary current - $I_{e \text{ in}}$), intermediate (2 - m.m.p. F_1 and 3- magnetic flow - F_2) and output (4 - a secondary voltage $U_{e \text{ out}}$) of the values of voltage under: normal (a), asymmetrical (b) mode and in mode of the short circuit (c) in electric networks of of Smart Grid energy system

As can be seen from the results of modeling and research based on the complex program MATLAB, connecting processes i.e. change the output voltage of are fixed through $0,044$ s. after enabling the electric load in current wire of the electric nets of Smart Grid energy system.

IV. CONCLUSION

In given article described methods and technological aspects of design of power supply systems and nets of smart grid and equipment's of control values and parameters of communication nets and power supply systems, analyzed: principles of design of power systems on the bases of Smart Grid; problems of research and design; allowed solve a problem development and construction efficient power systems. Used automatically controlled of the sources of reactive power in electric sets and power devices with nominal power 50 kVt and voltage till 500 kV, allowed increasing of capacity power equipment and energy, resource saving in elements of control voltage of the power supply of control system of Smart Grid.

REFERENCE

- [1] Siddikov I., SattarovKh.,Khujamatov H. Modeling of the Transformation Elements of Power Sources Control// 2017 International Conference on Information Science and Communications Technologies (ICISCT), November, 2017, Tashkent, Session 5. <https://www.tuit.uz/en/post/ilmijanjuman>.
- [2] Petrova I., Zaripova V, Lejnina Yu., Siddikov I. Automated system for synthesis of sensors for smart cities. xxii international scientific conference on advanced in civil engineering "construction the formation of living environment' Tashkent, Uzbekistan, 18-21 April, 2019 <https://www.scopus.com/record/display.uri?eid=2-s2.0-85067281218&origin=resultlist>

- [3] Zaripov M.F., Petrova I.Y. Предметно-ориентированная среда для поиска новых технических решений «Интеллект»// ИВ Санкт-Петербургская международная конф. «РИ-95»: Тез. докл. – Спб., 1995. – С. 60-61.
- [4] Zaripov M.F., Zaynullin N.R., Petrova I.Y. Графовой метод научно-технического творчества. – М.: ВНИИПИ ГКНТ, 1988. – 124 с.
- [5] Lukashkin V.G., Garipov V.K. Slepcev V.V., Matei Visniec A.V., Вишневков А.В. Автоматизация измерений, контроля и управления. – М.: Машиностроение, 2005.– 663 с.