THE PROBLEMS OF DISTRIBUTED GENERATION FUNCTIONING IN DISTRIBUTION POWER NETWORKS

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Introduction. Power statistics from RES (renewable energy sources) the International Energy Release Agency (IRENA) in 2020 shows that on new energy sources, mainly hydro- and wind power, solar, geothermal and bioenergy, 72% of the entire capacity growth came to the last year. Energy from RES has increased by 7.6% in 2019 by adding 176 GW of generating capacities in the world [1, 2].

The main directions in ensuring future world energy are the development of new technologies of production and transportation of energy resources, the formation of a "new energy", based on the RES, distributed generation, intellectualization in transport, in housing and communal services and industry. In this regard, the efficiency of energy use is one of the most important factors in scientific and technological progress, the development of production activities, services and stable work of energy production. Difficulty, significant financial costs for the construction and operation of the equipment of electric power objects, as well as the gradual growth of consumers' needs to the quality of electricity create a basis for optimizing technical solutions implemented in the generation sectors, transmission and distribution of electricity [3].

The key directive of the European Union for the use of renewable energy sources is the 2009/28 / EC directive, which establishes the overall limits for the development of renewable sources in order to achieve a common goal for the share of energy in the final energy consumption (electricity, heating and cooling) and to increase. The share of energy from renewable sources consumed in the transport sector. There are many mechanisms for stimulating the development of "green" energy. The EU member states apply the following main approaches:

1. Preferential systems («green» tariffs and allowances) based on pricing tools. The government fixes the price, the market solves the number.

2. Adjusting quotas using green certificates based on quantitative principle. Government fixes quantity, market sets the price.

The indicated tools can be used in various forms. Almost all EU Member States are used simultaneously a few support models, of which one-two are the main ones. In many cases, preferential systems are supplemented by other policy instruments, such as investment grants [4].

- **"Green" tariff.** "Green" tariff is a specially elevated electricity tariff, according to which the manufacturer is guaranteed to sell it. Usually it is set for a long period of gradual decrease in its magnitude and is differentiated for various technologies and capacities of installations (*Germany, Austria, Denmark, France*).

- **Quotes**. The regulator sets a certain minimum share of "green" electricity, which should be in the overall structure of electricity. In this case, the regulator imposes a commitment to use "green" electricity by establishing appropriate quotas. The system of such quotas is often combined using "green" certificates (*Sweden, Poland, Italy, Romania, Belgium*).

- **"Green" certificates.** Obligated by the quota, the Party issues an appropriate certificate for the volume of electricity produced. If more "green" energy is produced than the quota provided, the manufacturer can sell these volumes by a certificate to another subject, which has not yet complied with its obligations.

Results of the research. Today, under the object of the DG, the power plant is understood, so consisting of one or more generating installations connected to the DPN or to the internal power supply networks of consumers on the voltage to 110 kV inclusive, as close as possible to the nodes of the power supply, works in parallel with the electric power system (EPS) or in an island (standalone) mode [5].

Taking into account the peculiarity of our united power grid, DG objects can work as in parallel with the grid, as well as in island (autonomous) modes. Under the island regime, there are such a mode of operation of the power grid with one or more power plants (DG objects) that may have one or more gas turbine station (GTS), as well as the load, permissible by all power supply and electricity consumption, which is formed when switching off the transmission line which binds the electrical network with the grid (as a result of a short circuit or another reason) and exists until it is synchronized with the grid. Disconnecting the transmission line can be implemented automated (by the parameters of the electrical mode) or manually by regular staff to ensure reliable operation of generating objects and / or consumer power supply [6].

The work of the electric network in the island mode can last as much as you like. The duration of its operation depends on the state of the power lines, the parameters of the modes in the power system and / or in the allocated DPN, the decision of the next personnel, etc. As a rule, synchronization of the allocated DNP with the grid is carried out by appropriate automation devices.

Creation of an automatic control system (ACS) modes of DPN is an important and up-to-date task that needs to be solved with the use of modern software and hardware complexes (HC). Existing principles and approaches to an automated control do not allow in a full network to provide normal and emergency modes of SEM with RG objects, taking into account their features [7].

Features of electrical modes are most clearly manifested in the island (autonomous) mode of operation of DPN, since emergency processes in this case occur heavier for consumers than for a general purpose network, especially when emergency deficits. Sudden disconnections of one gum, group or entire power plant in the EEC can not cause significant power deficits and lead to a violation of consumer power supply, and in island mode - it is real. Depending on the schematic-mode conditions, the balance of generation and consumption in EM may vary from the excess of generation, which will lead to the shutdown of the GU, to a deficit [8].

In the distribution of electrical networks and internal power supply networks, devices are used (ARI linear, ARI sectional) and antiavarious automation (AFU - automatic frequency unloading, ALVR - automatic limitation of voltage reduction, AREO - automatic restriction of equipment overload). In the technological connection of DG objects, the schematic-regime situation in the adjacent network is dramatically changing. Accordingly, it is necessary to conduct a settlement analysis of the correctness of choosing algorithms of operation and setting parameters that are in operation of automation devices. These devices, as a rule, do not have technical capabilities to recognize regime areas and adapt algorithms to the current regime.

Support for the nominal frequency value in the EEC is carried out by the use of automatic regulation (SAP) systems, continuously controlling the balance of generated and consumed active power and implement the required control effect. In case of emergency disconnections, system-wide or local active power deficits may occur. In order to prevent an unacceptable decrease in frequency under the conditions of ensuring the stable operation of the GTS and electrical receivers of consumers, as well as its further recovery, devices AFU are used. The action of the AFU should provide damage to the interruption of electricity supply, as well as the continuity of the power supply of the most responsible consumers by disconnecting less responsible.

ARI devices are used in internal power supply networks to restore power plants by automatically joining backup administration (power source) with disrupted consumer electrical installations. ARI devices can be installed on power transformers, PL, sectional and tire switches. The accession of DG objects leads to a significant change in schematic-regime situations, influencing the AVR devices located in operation. In this regard, it is necessary to determine which changes in the devices of ARI (work algorithms; setting parameters) may be required in connection with the integration of GTS in those DPN nodes, where to this load was passive, that is, when moving from the circuit in Fig. 1., and to the scheme B.

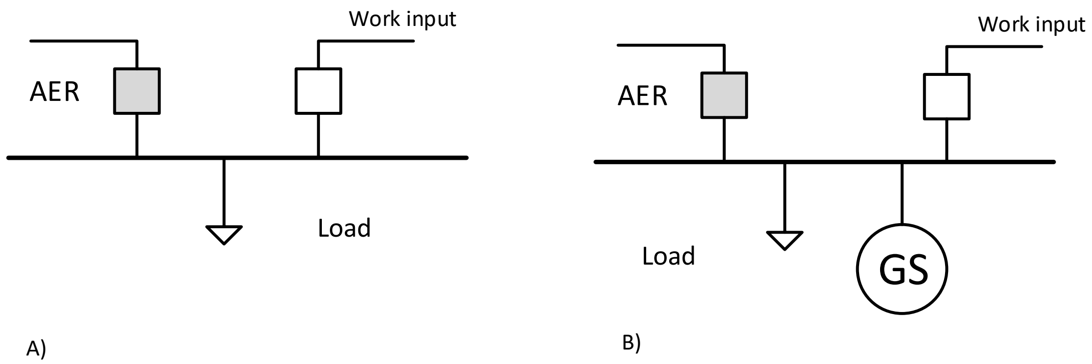

Fig 1. Principal single-line network scheme: A - without generating an object of dispersed generation; B - from the generator installation of the object of dispersed generation

Solving the issues of compatibility of ARI devices located in operation, and the newly-joined GTS objects need to take into account the requirements for the failure-free operation of the GTS / object of the DG when changing the parameters of the electrical network mode, as well as the significance of a particular GTS / object of DG in providing the reliability of consumer power supply. If you allow a temporary disabling of the GTS / object of the RG in the emergency network modes, at the time of the existence of such regimes, until they are re-inclusive, then two possible decisions should be analyzed:

- without changing the algorithm ARI to rotate the rotation of the GTS / Object to reduce the voltage on the outputs or in the case of inadmissibility of the use of AR on a single lepament of the PL of the DG with the power system, simultaneously envisaging the means of automation of re-enabling the GTS;
- change the algorithms of the work and settings for setting up devices ARI in such a way that the failure work of the GTS / object of DG was provided in various schematic-regime situations.

Conclusion. Taking into account the above prospects for the development of distribution electric networks with objects of dispersed generation, including RES, it is obvious to the relevance and importance of problems that arise in the functioning of automatic control systems normal and emergency modes. Modern development of information technologies provides extensive opportunities for solving the given tasks on a fundamentally new scientific and technological level with the use of modern software and hardware complexes.

Analysis of problematic issues of integration of DG objects, including RES, in distribution networks and internal power supply networks, showed the need to take measures for the phased transition of the EPS of Ukraine to the structure of the "Energy System of the Future" through the implementation of Smart GRID projects, introduction of electricity accumulation systems, creation of automatic systems Manage modes, etc.

Emergency processes in EM with modern DG objects, especially when functioning in island (autonomous) mode, have their specific features that are clearly manifested in the emergence of emergency power deficiencies that must be taken into account when designing antavaryanism to provide reliable electricity supply to consumers in different ways. Scheme-regime conditions. Integration of DG objects in the internal power supply network leads to a significant change in schematic-regime conditions that can lead to failures, as well as unnecessary and false treasures of antavarian automation devices. That is why it is necessary to improve the algorithms for the functioning of the devices of the AFU and ALVR, by providing adaptability to current schematic conditions.

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