

## Renewable Energy Sources-Receiver Switching

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### Introduction

Converters for renewable energy given the increased attention on climate change, clean energy production, as well as on price. One of the forms of renewable energy is electricity generated from different sources of energy is transformed into electrical energy. One of the electrical energy used is the source of the increased power, they are selling to distribution companies. These systems are well designed. Such a system follows the energy chain: the primary source of energy for electricity generator or transmitter, the systems are subdivided into two different systems. First, the source of great power, it is synchronized with the network and working directly to the network without any additional measures. Second, when resources are low-power generated electricity is handling the battery, and then through a converter to synchronize the work of the network are fed into the electricity grid. However, if the primary energy source is small power, the part of such a system: the battery and inverter and its synchronization with the network is expensive, compared to the obtainable of power levels.

Smallholdings in any area, any consumer of electricity power from autonomous sources of electrical power and electrical network [1]:

1. Wind power plant up to 5 kW;
2. Solar power plant components up to 5 kW;
3. Diesel generators to 10 kW using two biogas or dieseline. Biogas generator produces compile them into a tank and, if necessary, or over-use of resources and their diesel generators;
4. Electricity Network.

Sources such connection to the electricity grid will require these investments to their pay dividends will be very doubtful. So more and more questions raised or not to carry out the simpler measures [2]. In this article, and suggested one of the variant when renewable energy sources in energy use for its own affairs will not synchronize its settings with your network settings, but to ensure complete consumption of energy produced, and only when there are unfavorable conditions for the generation of electricity to charge the electric distribution network .

### Control system structure

The organization of such a system needs to be reformed and electricity consumers by dividing them in groups according to energy supply in accordance with the importance and power. The holding of this can be done by dividing the network into building the partition, or even in separate rooms and so on [3].

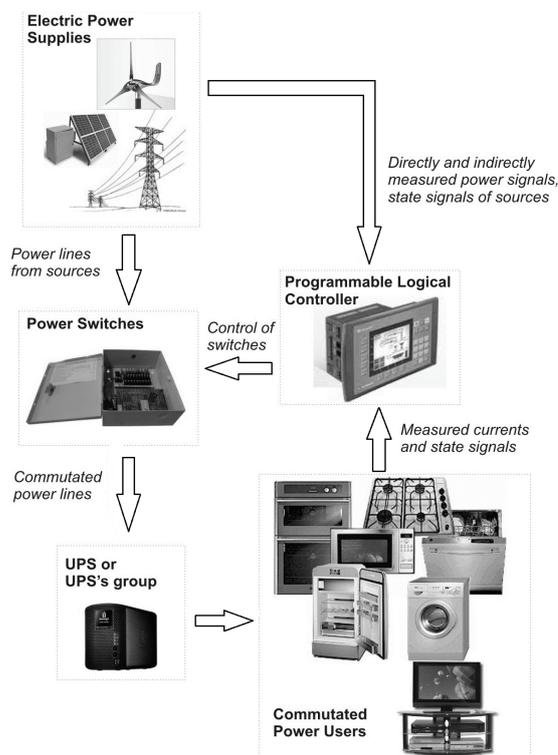


Fig. 1. The proposed control system

This control system would consist of four branches of power and energy industry customers, such as assessing the different objects which are the energy levels of the credibility (refrigerator, computer network, television, lighting, etc.) to produce 10 of these branches. Such a sys-



that the analog input signal content, which increases the cost of the switch, the proposed use multiplexor analog switches, switching signals in accordance with the matter of whether it is possible to control the cycle, but not less frequently than a minute.

Each analog input signal converted into power units using the linear dependence

$$PG = \frac{PG_{\max} - PG_{\min}}{MD_{\max} - MD_{\min}} (MD - MD_{\min}) + PG_{\min}, \quad (1)$$

where PG – predicted power; MD – measurement.

The proposed use and dependence straightened if the predicted power dependence of the measured rate is not linear due to a simpler calculation algorithm. The more complex calculations can impede the realization of PLC, knowing that most of the cheaper controllers do not have developed a library of arithmetic functions and programmed using the contact plan. Curve straightening system will have a significant impact, because the measurement values shall be used only capture the moment of switching.

Realization of PLC programming is used in the following information:

1. Priorities sources (sources must be marked on the priorities);
2. Introduction of the linear power dependence calculate parameters;
3. Determine the method of control (manual, automatic);
4. Each receiver must be the priority;
5. For each potential receiver of the sources some can used;
6. Sources, switching the order (priority);
7. Switching nature of the sources (manual, automatic);
8. Measured analog signal scaling.

The first switching time, switching is performed with the main network provider to be checked whether there is a network-lines (source) voltage, transmitting information about the discrete signals to the control, if the source is not formed in the respective signs of inactivity, if not and source from "basic supplier" Starting emergency source e.g.: diesel generator. Commutated to the source, only assign a receiver in accordance with priority.

The source of the "principal supplier" of the tension checked the selected mode of operation "Auto" or "Manual". Manual mode the user selects a menu of switched receivers to the sources. Automatic mode, all receivers commutated to the source of "principal supplier" to the primary energy consumption by measuring the flow lines to inverters 25 A and the transfer of this information into the control 0-10V DC signal. Measured current recalculate into power. It is also continuously measured parameters of alternative sources, which transmitted to the control of analog inputs, 0-10V DC voltage signal, which is the source data to calculate the preliminary (estimated) power source.

According to the chosen method of control - the lowest power margin or priority the receivers commutated to the concerned of the sources.

One of the methods the control, is the lowest power margin.. Calculated the error rates of all the power, if there is a source of benefit, i.e. source of power is greater than the amount required receiver, receiver selection is carried out with minimum error. The switching to the alternative source of power receiver are executed with minimal error. Source selection for each receiver is carried out separately. Efficiency is increased if the additional assessment and priority assignment.

Another method of control is according to priorities. Ask receivers sources of priorities allows fast switch sources according to user-defined procedure if there is sufficient power, without evaluation of whether it is effectively harnessed. But in this case needed for each receiver in accordance with the priorities of resource allocation and by the receiver. This method is simpler, but may be less effective work.

After the assignment of resources receiver begins to work or normal system shutdown procedure from the source. As shown by the modeling results: increasing the load-switching source, the transition process brings override (voltage drop) is not greater than 10%, but the system is stabilized, if a sufficient source of power. The increased load to the "unacceptable" level, the voltage drops more than 10%, which is a source of "failures". In this case, the necessary disconnection from an alternative source to source and switch from the main supplier. In order to reduce the frequent switching is appropriate to limit the formation of an alternative source per unit time, say after 10 minutes.

### Network switch model and transient analysis

All sources of autonomous generators with astatic voltage regulators, which satisfy the bandwidth requirements of users (transition duration 20ms).

Simulation modeling tool chosen for the original CENTAURUS CPN, the processes taking place energy sources to model the system using a programming analog modeling sub-system, management modeling using color petri nets sub-system.

The wind power plants, approximately determined by measuring the wind speed ranges from 0 to 100% at 10%, turning the generator of random variables.

The solar power plants, approximately determined by measuring the amount of illumination from 0 to 100% at 10%, turning the generator of random variables.

Maximum continuous power output of the network, only the generator of random values generated by two mode, network of 220 V and is 0 V.

Diesel generator is activated automatically on loss of line voltage actuation is carried out 7 seconds

Online users load asynchronously generated random generators in the range from 0 to 100% in 10%, a maximum of 2 kW for each line.

The voltage of generator is measured by two sensors: one of them captures the moment when the generator is started after parking, because of its connection to the place only if the transition process is finished when it starts. Another sensor captures the moment when the voltage fell below the acceptable limits and the need disconnect the employ one of and connect it to the next energy source.

Providing modeling the sensor voltage was set 200 V voltage, such as short-term fluctuations within a period of one service should not affect the consumer, but the necessary measures for long-term survival of the voltage drop in the eradication of which connect user to the next energy source.

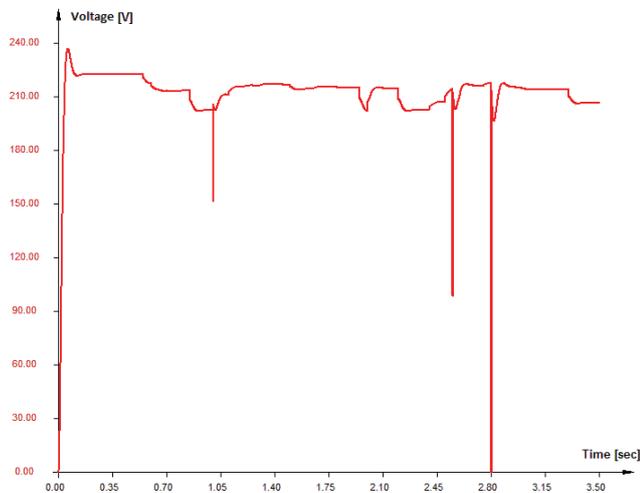


Fig. 3. Wind generator voltage

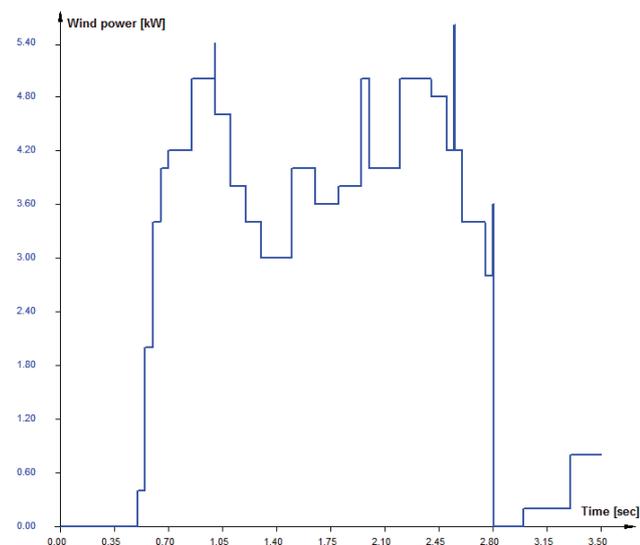


Fig. 4. Wind generator power

If the voltage drop is higher, and it comes when one may carry out a sharp increase in both the source voltage cannot ensure the tasks within. The time interval between the start of the load connection, the voltage drop, load-off voltage and recovery 4 ms.

In Fig. 3 and Fig. 4 show that at time 1.05 sec was connected to the load, and immediately cut off, because voltage has fallen below 200 V. At the time 2.5 sec - were connected load, and immediately cut off, because voltage has fallen below the 200 V. At the time 2.8 sec cut off the generator full load and connections are made gradually

## Conclusions

The PLC can fully realize the target set, it requires:

1. The relevant characteristics of the voltage regulators and generators in the system (no more than 0.1 seconds for the transitional process);
2. Triacs for switching, whose reaction to the ruling of a network signal does not exceed the half-life is 10 msec.

Considering that the model has all the control functions of modeling, so that interruptions to the program, the organization, functioning piece of software should be a maximum of 10 msec, where it will quickly realize, everything will depend on the switching bandwidth.

It is advisable that the circuit: sensor, PLC and the switch not delay more time than 10 msec.

## References

1. **Adomavičius V.** Sizing of wind-based energy system for homestead's power and heat // *Electrical and Control Technologies*. – IFAC Committee of National Organization, Lithuanian Electricity Association, 2007. – P. 157–162.
2. **Katawaluwa M., et. al.** Simulation of Wind heat Generator // *IEEE International Conference on Electro // Information Technology*, 2006. – P. 479–482.
3. **Kepalas V., Ramonas Č., Adomavičius V.** Connection of the RES-based Power Plants into the Electric Grid // *Electronics and Electrical Engineering*. – Kaunas: Technologija, 2007. – No. 8(80). – P. 67–72.

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Proposed and tested stand-alone renewable energy sources without the use of the energy output of the network. This is an important low-power renewable energy sources because there is no need to convert energy in the network when the be performed relatively expensive equipment. Sources are allocated to the commutated electric energy consumers, relatively inexpensive triac's switches. PLC control are provided the measurement of direct and indirect energy parameters. Verified that the switching process is the duration of the a user, even is not observed. Ill. 4, bibl. 3, tabl. 1 (in English; abstracts in English and Lithuanian).

**L. Balaševičius, G. Dervinis, K. Šarkauskas. Atsinaujinančių energijos šaltinių-įmuvų komutacija // Elektronika ir elektrotechnika. – Kaunas: Technologija, 2011. – Nr. 8(114). – P. 89–92.**

Pasiūlyta ir patikrinta, kaip atsinaujinančius energijos šaltinius galima autonomiškai panaudoti neatiduodant energijos į tinklą. Tai svarbu, kai atsinaujinantys energijos šaltiniai yra nedidelės galios, nes energijos nereikia konvertuoti. Šaltiniai yra komutuojami su paskirstytaisiais elektros energijos vartotojais, palyginti nebrangiais semistoriniais komutatoriais. Valdymas atliekamas su PLC, matuojant tiesioginius ir netiesioginius energijos parametrus. Patikrinta, kad komutacinių procesų trukmės vartotojai nepastebi. Il. 4, bibl. 3, lent. 1 (anglų kalba; santraukos anglų ir lietuvių k.).