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Measurements of the quality of the electric energy produced in water and wind power stations

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Measurements of the quality of the electric energy produced in a water power house and wind power station

The results of measurements of the quality of the electric energy produced in a water power house in Jastrzębniki and wind power station are presented in the publication. They were analyzed in compatibility with the required norm PN-EN 50160. The problem of the quality of electric energy as well as its influence on the appropriate functioning of electrical power engineering system were roughly discussed.

1. INTRODUCTION

Poland as the member of hte European Union as well as signatory of a Climatic Conference and Kioto Protocol, undertook a number of obligations concerning structural changes both in energy politics and in energetic sector. The resources running out of the conventional fuels, the lack of social approval for the nuclear power, and the degradation of the environment, contributed to the fact that a rank of Renewable Sources of Energy became higher.(OZE). European Union, wanting to assure a balanced development of the energy sector as well as the energetic safety accepted "White Book" – Energy for the mankind the renewable sources of energy. The main purpose of this document is increasing OZE participation in the fuels and energy consumption.

2. PARAMETERS STATING THE QUALITY OF THE ELECTRIC ENERGY ACCORDING TO PN-EN 50160

Parameters characterising the quaolity of hte energy:

- Voltage changes
- Flickering P_{st}/P_{lt}
- Harmonic: (from 2 to 40)
- Frequency
- Assymetry of 1 and 3-phase powering systems
- Falls, voltage surges
- Breaks at powering.

Definitions of parameters and its possible values, the so-called qualitative standards were determined in PN-EN 50160 norm, and are applied in the places called the points of connecting the recipient and energy supplier. [2]

3. MEASURING THE QUALITY OF PARAMETERS OF ELECTRIC ENERGY PRODUCED IN MEW JASTRZĘBNIKI

The basic technical parameters of the generator:

- type: asynchronous,
- active rated power: $P_N = 70$ kW
- apparent rated power: $S_N = 87$ kVA
- power rate: $\cos\varphi = 0{,}97$ at P_N
- rated voltage: $U_N = 400$ V
- rated current at: $\cos\varphi = 1$ $I_N = 105$ A
- rounds per minute: 1000 RPM. [3]

The results of the exemplary measurements parameters of energy quality.

Symbol	Tolerance Range	L1L2 [%]	L2L3 [%]	L3L1 [%]
P_{lt}	0.00 - 1.00	98.80	98.80	98.80

Tab. 1: Flickering ratio -statistics [3]

Symbol	Tolerance Range	Values 95%			Max values		
		L1L2	L2L3	L3L1	L1L2	L2L3	L3L1
P_{lt}	0.00 – 1.00	0.74	0.71	0.73	1.03	1.04	1.02

Tab. 2: Flickering ratio – measured values [3]

Symbol	Tolerance Range	L1L2	L2L3	L3L1
	[V]	[%]	[%]	[%]
Interfacial voltage 95%	360.00 - 440.00	100.00	100.00	100.00
Interfacial voltages 100%	340.00 - 440.00	100.00	100.00	100.00

Tab. 3:Voltage measurement –statistics [3]

Symbol	Tolerance range	L1L2	L2L3	L3L1
	[V]	[V]	[V]	[V]
Voltage growth 100%	440.00	398.85	399.11	398.60
Voltage growth 95%	440.00	397.31	397.22	397.15
Voltage drop 95%	360.00	385.93	385.64	385.72
Voltage drop 100%	340.00	377.93	377.87	378.13

Tab. 4: Voltage drops. [3]

4. MEASURING THE QUALITY OF PARAMETERS OF ELECTRIC ENERGY IN ENERCON E48 WIND MILL.

Measuring the quality of electric energy was carried out in the point of connecting to the electro-energetic network at the side of a low 400 V voltage. Measuring process was carried out according to the meteology recommended in PN EN 61400-21 norm. *Measurement and the assessment of parameters of the energy quality supplied by wind turbine sets connected to the electro-energetic network.* The measurements were carried out within the period of one week.

The basic technical parameters of ENERCON E48 power plant:

- generator type: synchronous,
- active rated power: P_N = 800 kW
- apparent rated power: S_N = 801kVA
- power ratio: cosφ = 1 przy P_N
- rated voltage: U_N = 400 V
- rated current: at cosφ = 1 I_N = 1156 A
- rounds per minute: 1000 RPM.

Symbol	Tolerance range	L1 [%]	L2 [%]	L3 [%]
P_{lt}	0.00 - 1.00	100	100	100

Tab. 5: Flickering ratio measurement -statistics [4]

Symbol	Tolerance range	Values 95%			Max values		
		L1	L2	L3	L1	L2	L3
P_{lt}	0.00 - 1.00	0.26	0.26	0.26	0,35	0,32	0,31

Tab. 6: Measured values of flickering ratio [4]

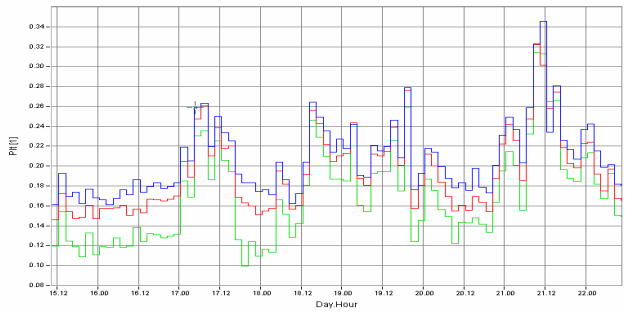

Fig. 1:Value of light flickering ratio P_{Lt}.

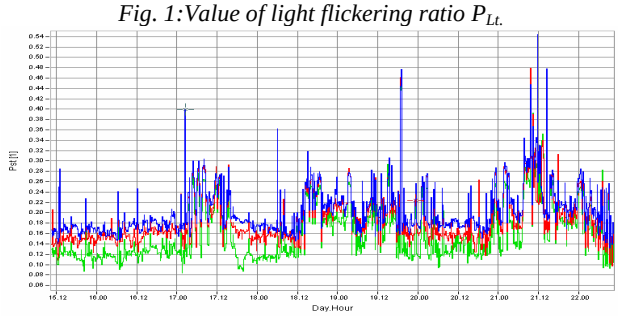

Fig.2: Value of light flickering ratio P_{st}

5. CHARACTERISTICS OF QUALITY ANALYSER OF ELECTRIC ENERGY TOPAS 2000.

TOPAS 2000 is an analyser of the quality of the electric energy, an can be used for discovering the sources of disruptions and the assessment of the voltage quality of the powering grid with reference to the compulsory standards. It enables long-term collecting of measurement data (few months) as well as these data transmission ON – LINE to the computer with the purpose of its further analysis. TOPAS 2000 measures 4 currents and 4 or 8 voltages. The results of the measurements can be presented in the form of time courses and in the frequency function. The total error of the measurement including the error of voltage sonde, is lower than the error of measuring devices of 0,5 class.[5]

6. COMMENTS AND CONCLUSIONS

All the studies carried out to check the quality of energy produced in water power house and wind power station confirm that:

- they produce electric energy of parameters complied with PN-EN 50160 norm.
- measurements and analysis of the recorder results allow to state that the voltage in 100% is contained in tolerable range.
- the recorded value of P_{lt} ratio does not exceed the value specified in PN-EN 50160 norm through 95% of the week time.
- the comparative value is usually adopted as a norm value which, with 95% probability, is not exceeded in the time of measurements. It means that momentary values can exceed the criterial value through 5% of observation time.

5. SUMMARY

The basic advantage resulting from using water and wind power stations, means saving a specified amount of mineral fuel with simultaneous avoiding the costs of its extracting (the energy used up for its extract and transport). The electric energy is a product and as every product it should meet some qualitative requirements. Quite considerable part of devices used universally requires fulfilling standards of high quality energy. With concern for a stability of the electro-energetic system and the quality of electric energy, the devices and installations friendly for the powering network should be promoted.

LITERATURE

[1] The Act Book No 2, Ordinance of the Ministry of Economy and Labour dated on 20th Dec 2004 referring to the detailed conditions of connecting the subjects to electr-energetic networks, to its motion and exploitation.

[2] PN-EN 50160 December 2002: Parameters of the voltage powering the public distributive networks.

[3] Study: Measuring the parameters of electric energy quality of the water plant in Jastrzebniki – Poznań September 2006

[4] Study: Measuring the parameters of electric energy quality of the wind mill - Poznań September 2006

[5] catalogue card Topas 2000

[6] website - http://cire.pl