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PROBLEMS OF THE HIGHER HARMONIOUS IN MODERN DISTRIBUTIVE NETWORKS, POSSIBILITY OF THE DEVELOPED DEVICE OF HIGHER HARMONIOUS REGISTRATION

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Electric energy quality (EQ) is defined by the set of its characteristics at which electroreceivers (ER) can normally operate and carry out the duty functions put. State standard 13109-97 «Norms of electric energy quality in systems of general purpose electrosupply» establishes indicators and norms of electric power quality in electric networks of electrosupply systems of general purpose three-phase and single-phase, a.c.

EEQ at the place of manufacture does not guarantee its quality on a consumption place. Before inclusion of electric receivers (ER) in a point of their joining to an electric network EEQ can be different. EEQ is also characterised by the term «electromagnetic compatibility». Ander the terms electromagnetic compatibility is meant ability of ER to function normally in electromagnetic (electric) environment, not creating inadmissible electromagnetic hindrances for other ER, functioning in the same environment.

Norms EEQ established by the standard, are levels of electromagnetic compatibility for conductive electromagnetic hindrances in systems of electrosupply of a general purpose. At observance of established norms EEQ electromagnetic compatibility of electric networks supplied the organizations and electric networks of consumers of electric energy or ER is provided.

ER with nonlinear volt-ampere characteristics consume from a network by not sinusoidal currents at leading sinusoidal voltage to their terminals. Currents of higher harmonics, passing through the network elements, produce power failures in resistance of these elements and, being imposed on the basic sinusoid voltage, lead to distortions of the form of a curve of pressure in knots of an electric network. In this connection ER with nonlinear volt-ampere characteristics often are named sources of higher harmonics.

Most gross EEQ infringements in an electric network take place at the operation powerful operated valve converters.

Depending on the straightening scheme valves converters generate following harmonics of a current in a network: at the 6-phase scheme – to 19th order; at the 12-phase scheme – to 25th order inclusive.

The distortion factor sine-sharpe curve in networks with electro arc steel-smelting and thermal ore furnaces is defined by a voltage curve in basic 2, 3, 4, 5, 7th harmonics.

The distortion factor sine-sharpe curve is defined by a installations of arc and contact welding curve voltage in basic 5, 7, 11, 13th harmonics.

Currents of 3rd and 5th harmonics of gas-discharge lamps make 10 and 3 % from a current of 1st harmonic. These currents coincide on a phase in corresponding linear wires of a network and, developing in a zero wire of a network 380/220V, cause current in it, which is equal to a current in a phase wire.

Researches of magnetisation current curve the transformers switch on network of sinusoidal voltage, have shown, that in an electric network there are all odd harmonics, including harmonics, multiple to three /1/. Harmonics, multiple to three, are caused by asymmetry of magnetising currents on phases.

Magnetisation currents form systems of currents of direct and return sequence which on absolute size are identical to harmonics, multiple to three. For other odd harmonics currents of return sequence make about 0,25 currents of direct sequence.

If on inputs of transformers not sinusoidal voltage moves there are additional components of the higher harmonics of a current. Transformers of GPP give 5th harmonic of small size.

As a whole not sinusoidal modes possess the same lacks, as asymmetrical.

The higher harmonics of a current and pressure cause additional losses of active capacity in all elements of system of electrosupply: in transmission lines, transformers, electric cars, static condensers as resistance of these elements depend on frequency.

So, for example, the capacitance of the condensers established with a view of indemnification of jet capacity, with increase of frequency of brought voltage decreases. Therefore, if in pressure of a power line there are the higher harmonics resistance condensers on these harmonics appears much more low, than on frequency of 50 Hz. Because of it in the condensers intended for indemnification of jet capacity, even small pressure of the higher harmonics can cause considerable currents of harmonics. At the enterprises with the big relative density of nonlinear loadings of the battery of condensers operate badly. They or are disconnected by protection against an overload on a current or for short term fail because of damage condensator (or the accelerated ageing of isolation). Cases when at the enterprises with the developed cable network voltage 6-10 kV batteries of condensers appear in a mode of a resonance of currents (or close to this mode) on frequency any of harmonics that leads to their dangerous overload on a current are known.

The higher harmonics cause:

− parasitic fields and electromagnetic moments in synchronous and asynchronous machines which worsen mechanical characteristics and performance. As a result of the irreversible physical and chemical processes proceeding under the influence of fields of higher harmonics, and also the raised heating of current carrying parts it is observed;

− the accelerated ageing of isolation of electric machines, transformers, cables;

− deterioration of power factor ER;

− deterioration or infringement of work of devices of automatics, telemechanics, the computer technics and other devices with electronic elements;

− errors of measurements of induction counters of the electric power which lead to the incomplete account of the consumed electric power;

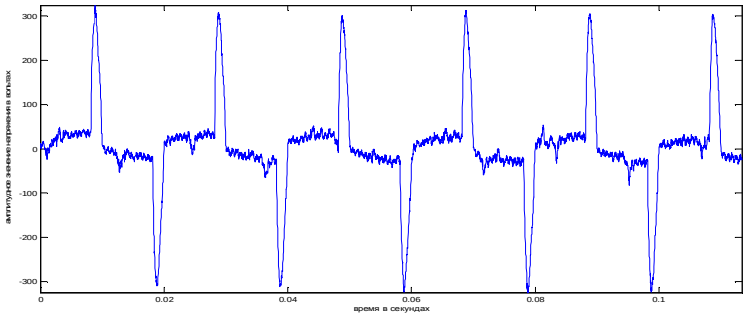
− infringement of work valve converters at high level of the higher harmonious components;

− presence of the higher harmonics adversely affects work not only electric equipments of consumers, but also electronic devices in power supply systems.

The curve of the pressure brought to ER, should not contain the higher harmonics in the established operating mode of the electric system. It is necessary to underline, that in working conditions ER, non sine-sharpe cirve voltage is shown together with actions of other influencing factors and consequently it is necessary to consider all set of factors in common.

The problem of struggle against the higher harmonious is connected also with the limited technical possibilities of modern analyzers EEQ (the number of analyzed harmonics does not exceed 40÷80). In work /2/ the example the voltage oscillogram in a network 10 kV with value electric drive of rolling mill which as a result was achieved was 100th harmonic is allocated. Harmonics of frequency rate 60 and 80 with amplitude to 15 % were observed. The factor sine-sharpe curve voltage, in accordance with state standart with the account to 40th harmonic, is equal 8,4 % while at the account of wider harmonious spectrum the given factor

is equal 20 %. In this case, on a share of harmonics of an order more 40th is necessary 11,6 %, that considerably exceeds standard values.



On fig. 1 the voltage oscillogram (phase pressure) on cable input 0,4 kV one of technical colleges is resulted.

Fig. 1 - Voltage oscillogram in a real distributive network

For definition of harmonious structure of an information signal of pressure the analyzer EEQ, developed by the authors of the article was used ./3/ At voltage decomposition voltage a power network on harmonics to 40th inclusive, the spectral structure of a power signal is presented in Fig. 2.

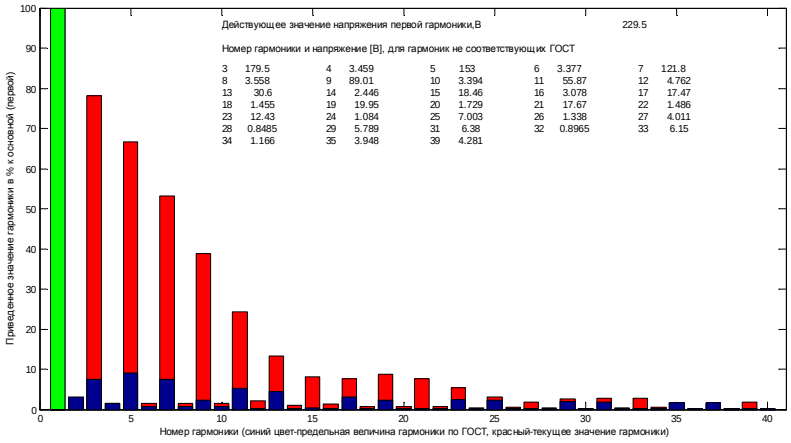


Fig. 2 Spectral structure of a power signal (to 40th harmonic)

At more detailed spectral analysis (fig. 3) it is possible to observe considerable excess of a marginal voltage level for some harmonics with numbers more than 40.

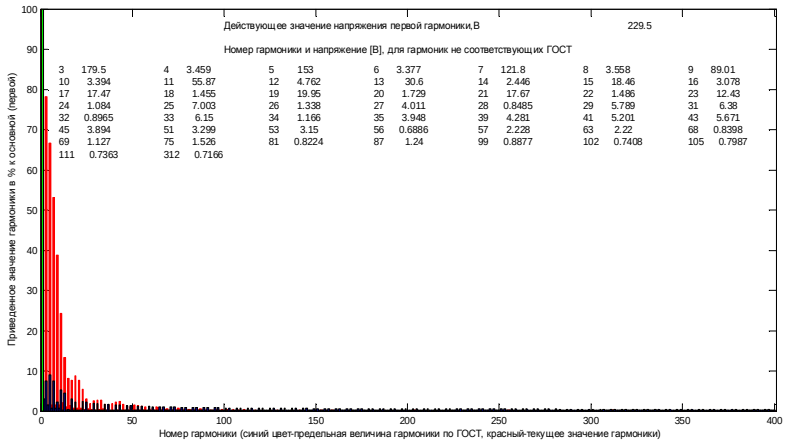


Fig. 3 Spectral structure of a power signal (to 400th harmonic)

It is necessary to notice, that the developed analyzer of EEQ practically in real time is capable to estimate structure of a power signal up to 200 harmonics at a relative error in 1 %. In total limiting number of analyzed harmonics (subharmonics) makes 4000. Analysis time in this case, at the declared error after numbering of a power signal, does not exceed one minute.

Conclusion:

- For struggle against the higher harmonics it is necessary to define precisely harmonious structure of currents and voltage, power consumptions in places of connection ER, character of power supplies that is possible only at use of special measuring devices capable to spend wide harmonious structure of information power signals.

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