Interaction Processes of Converters with Power Network

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Abstract - **In this present paper the investigation of the main quality voltage factors of the network are described. It is in the connection of the 3 - phase semiconductor regulator (converter) of the AC voltage with a load (star circuit) in zeroing cable. These two factors are coefficient of the non-sinuous and the relative deviation of the voltage. The work is done using computer modeling of the system power network – TPSR.**

Key words - **regulator, converters, electromagnetic compatability.**

I.INTRODUCTION.

As a rule switching of the converting devices (CD) to power net (PN) is following with bad back influence (BB I) on it. BB I from the point of the term “electromagnetic computability view of has two main aspect – energy and information [5].

The energy aspect appears as a worsening the quality of electrical power and the condition of its transport and use. The information aspect is connected with the generation of “noises” disturbing the normal operation of other devices connected to the net.

II.DESCRIPTION OF THE METHODOLOGY.

The goal of this work are the investigation of two main voltage quality parameters of the net in the point of connection of 3- phase semiconductor regulator (converter) of AC with star circuit load with zeroing cable. These are coefficient of the non-sinuous and the relative deviation of the voltage.

Computer modeling of the power system – TPSR in the next condition provides the research:

- Method of regulation – phase;
- Power range of the loads $S_T = (1 \div 400) kVA$;
- Ratio between the power of feeding transformer and the load $S_{TR} / S_T = (33 \div 1)$;
- Load`s factor $\cos\phi = (0.4 \div 1)$;
- TPR works in low voltage net 380 V;
- It is supposed that the system and load are symmetrical.

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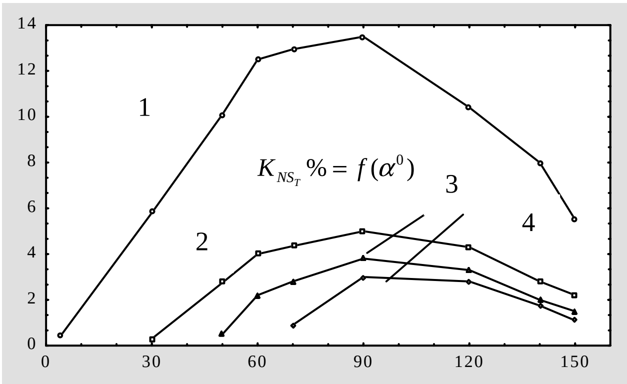
The used equivalent circuit is shown in [6]. Main attention is paid oh the coefficient of non-sinuous (K_{NS_T}) of the transformer voltage. Under this term understands the ratio between the effective values of all high harmonics and the whole effective voltage value in percents.

After these conditions the dependence of K_{NS_T} by phase angle α ($\cos\varphi_t$ is a parameter of the load) are downed. The characteristic of that dependence is that they have maximum values at $\alpha = 90^0$. It is connected with the strong distortion of the current´s shape and the circulation of the still valuable energy at $\alpha = 90^0$. Decreasing of $\cos\varphi_t$ in the time of keeping the full power of the load constant, made to significant decreasing of the values of K_{NS_T}. This is result of increasing filtering properties of the load inductance. On Fig. 1 the dependencies of K_{NS_T} as a function of the phase angle α ($\cos\varphi_t$ is the parameter) are shown. The circuit of the load



is star connection with zeroing cable and ratio between $S_{TR} / S_T = 1$ and $S_T = 100kVA$.

Fig. 1. Dependence of the K_{NS_T} as a function of α.
1 - $\cos\varphi_t = 1$, 2 - $\cos\varphi_t = 0.9$, 3 - $\cos\varphi_t = 0.7$, $\cos\varphi_t = 0.4$.

As it could be seen from Fig. 1 with increasing of $\cos\varphi_t$, especially over 0.9 K_{NS_T} sharply increases and significantly jumps over 5%, with are determined by the standards [1 – 4]. This significant increasing of the value, limited by the standard is observed in small values of the ratio S_{TR} / S_T. On Fig. 2 is shown the dependence of K_{NS_T}, from the ratio S_{TR} / S_T, with parameter $\cos\varphi_t$, in the star connection circuit.

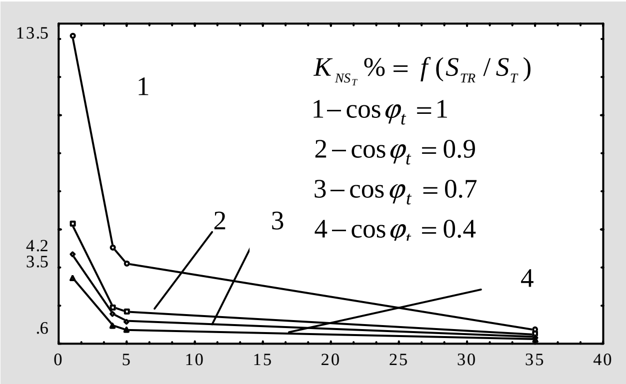


Fig. 2. Dependence of the K_{NS_T}, from the ratio S_{TR} / S_T .

Of the load with zeroing cable, with phase angle of commanding $\alpha = 90^0$. From at and other similar dependencies, got with different angles α and different connection circuit of the that load it could by make a conclusion the decreasing of the ratio S_{TR} / S_T under definite value, soon equal to 5 is undesired, because this leads to sharp increasing of K_{NS_T} over limited from the standard 5%.

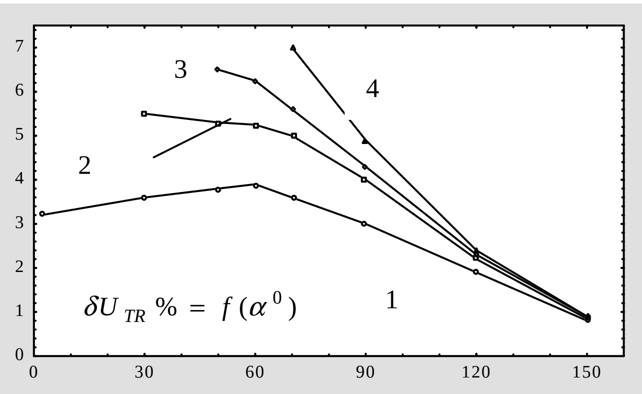


Fig. 3. Dependence of the δU_{TR} by the volume of α .

1 - $\cos\varphi_t = 1$, 2 - $\cos\varphi_t = 0.9$, 3 - $\cos\varphi_t = 0.7$, $\cos\varphi_t = 0.4$.

This is a result of increasing the roll of the like and transformer inductance with increasing load´s power versus this of the transformer. In the comparison of the results of the there connection circuit of the load it could be mentioned, that in a star circuit connection with zeroing cable, especially in $\cos\varphi_t = 1$ and small ratio S_{TR} / S_T , K_{NS_T} has greater values from these in the connection circuit of the load and star with out zeroing cable.

Other main parameter for the quality of the electric power is the relative deviation of the voltage in the low voltage output of the transformer. According to the common standards this is the difference between real value of the voltage and its nominal value in percent of the nominal voltage. On Fig. 3 it is shown the dependence of δU_{TR} by the volume of the phase angle α with a parameter $\cos\varphi_t$, and with ratio $S_{TR} / S_T = 1$. It could be seen, that with increasing of angle α, δU_{TR} decreases. This decreasing is significant after the angle $\alpha = 60^0$ and this is so more sensitive as $\cos\varphi_t$ is smaller, with is connected with the bigger rate of change of the reactive power with the chance of angle α. It is could be seen from Fig. 3, in small values of $\cos\varphi_t$ and smaller angles α, again we have surpass the limited of the standard 5% for δU_{TR} [1 – 4].

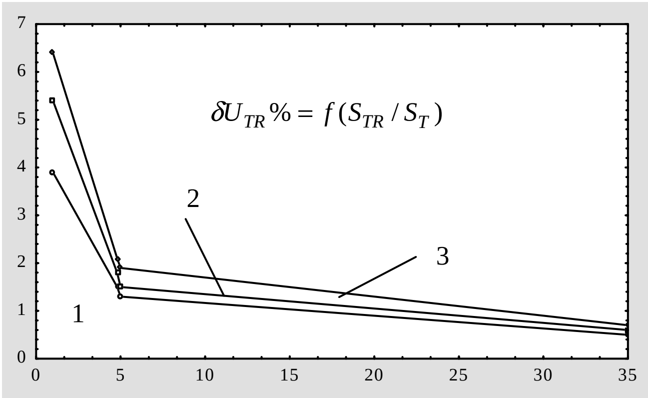


Fig. 4. Dependence of the δU_{TR} from the ratio S_{TR} / S_T .

1 - $\cos\varphi_t = 1$, 2 - $\cos\varphi_t = 0.9$, 3 - $\cos\varphi_t = 0.7$.

On the Fig. 4 is shown the dependence of δU_{TR} from the values of the ratio S_{TR} / S_T , with parameter $\cos\varphi_t$ and angle $\alpha = 60^0$. From them this seen that in an angle α, smaller 90^0 and $\cos\varphi_t$ smaller than 0.7 and S_{TR} / S_T smaller than determined value, soon equal to it is possible surpass of the limited from standard 5%. This is a result of the sharp increasing of the role of the line and transformer impedance with increasing the power of the load connected with decreasing of the values of the load inductance and resistance.

III.CONCLUSIONS.

1. It is pressed a method for evaluation of the interaction of the 3 phase semiconductor regulators using ratio S_{TR} / S_T .
2. Practically used results are received for evaluation of the energetic characteristics of 3 phase semiconductor regulators.

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