

ANALYSE THE WORK OF A capacitor WITH NONLINEAR LOAD SYSTEM

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Installation of capacitor banks (CB) in 6 - 10 kV power systems with a higher harmonics source can lead to parallel resonance with the network. This leads to an increase in current harmonics (CH) flowing through the mains supply and the capacitors to a value of tens and hundreds of times greater than the flux values of higher harmonics and their sources.

The possibility of resonance in power systems of factory (BAOK) network is tested. To power the internal transport, traction rectifier substation is used, that contains the installation ВАРКІЕ – 2000 – 600Н – УХЛІУ. A simplified equivalent circuit composed of a full wiring diagram, part of the network is shown in Figure 1

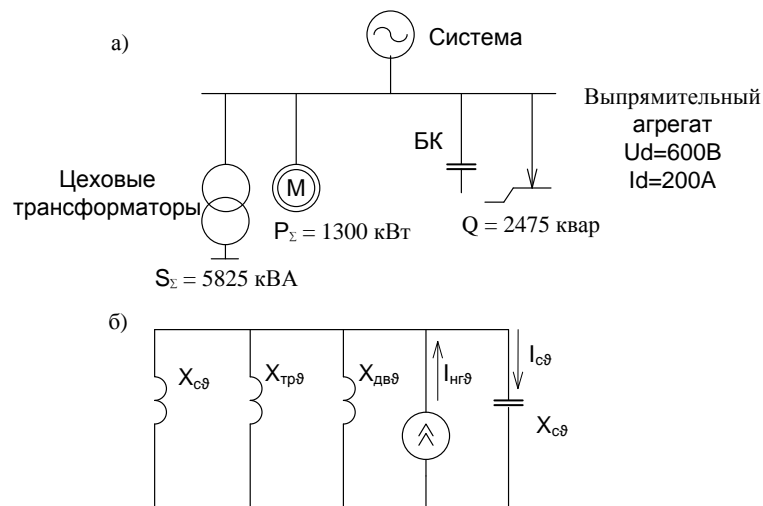


Fig 1 – К расчету токов ВГ:
 а) simplified source; б) equivalent scheme of v -й harmonics

The possibility of a resonance condition of Capacitor bank current can be calculated by the formula

$$g_{XL} = X_C / g$$

From there we calculate the number of harmonics with a possible resonance

$$g = \sqrt{X_C / X_L}$$

Detuning from resonance is fulfilled by the lowest frequencies of the harmonics at the connection point of capacitors, so the higher harmonics of the resultant resistance of the reactor and the capacitor is always inductive.

The calculation of harmonic flows that occur in electrical circuits, for the equivalent scheme is drawn separately for each harmonic. In this scheme, all the equivalent loads in the branches are joined together. The energy system of the network is supplied from converters.

- . Resistance of the equivalent scheme of v -й harmonics is calculated according to [1].
- First harmonics of a load current is determined by.

$$I_1 = 0,9 \frac{U_{d \text{ ном}} \cdot I_{d \text{ ном}}}{\sqrt{3} \cdot U_{\text{ном}} \cdot \cos \varphi} = 0,9 \frac{600 \cdot 2000}{\sqrt{3} \cdot 6000 \cdot 0,7} = 148,6 \text{ А.}$$

Величины токов учитываемых гармоник (5, 7, 11, 13) равнялись $I_5 = 26,8 \text{ А}$; $I_7 = 19,12 \text{ А}$; $I_{11} = 12,17 \text{ А}$; $I_{13} = 10,3 \text{ А}$.

Ток батареи конденсаторов рассчитывается по формуле

$$I_C = \frac{Q_{БК}}{\sqrt{3} \cdot U_{\text{ном}}}.$$

Value of current at maximum (2475квар) and minimum (450квар) power БК equal $I_{C \text{ max}} = 238 \text{ А}$ и $I_{C \text{ min}} = 43 \text{ А}$.

Calculation of coefficient ratio and current harmonics is shown in the table below. Table. 1.

Таблица 1 – coefficient ratio and current harmonics ВГ in a network БК

Номер гармоники	$Q_{БК} = 450 \text{ квар}$		$Q_{БК} = 2475 \text{ квар}$	
	$k_{B \nu}$	$I_{CB}, \text{ А}$	$k_{B \nu}$	$I_{CB}, \text{ А}$
5	0,129	3,46	-1,71	45,8
7	0,29	5,52	5,22	99,8
11	1,24	15,1	1,48	18
13	3,4	35,1	1,3	13,45

The equivalent current of the battery and the ratio of overload is calculated only at QBK max as I_B , with minimum current capacitor $Q_{БКmin}(35,1 < 43 \text{ А})$.

The values of equivalent current overload and multiplicity are as follows

$$I_{ЭКВ} = \sqrt{238^2 + 45,8^2 + 99,8^2 + 18^2 + 13,45^2} = 263,1 \text{ А,}$$

$$k_{II} = \frac{263,1}{238} = 1,105.$$

The calculation results show that overloading of capacitors is 10.5%, which is less than 15% at which КУ disallowed to operate.

Network parameters causes a resonance close to 7 harmonic, this value is the largest in the harmonic spectrum for a given installation

БІБЛІОГРАФІЧНІ ДАНІ

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