

Estimation of deformation of the voltage in the power system supplying 12-pulse rectifier

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Abstract The paper presents the results of the analysis of voltage distortions in the transformer station 220/15kV on the 15kV side. This transformer supplies the 3kV DC traction substation containing 12-phase converters. The level and the instantaneous waveform on the 15kV side voltage and loading current have been registered and used for the investigation of the influence of the converters on the parameters of the energy of the supplying system. Additional registration has been done of the low voltage. The paper presents the comparison of the real measurements with the results of computer simulation obtained using Microcap.

Keywords higher harmonics of voltage, 12-pulse rectifier

I. INTRODUCTION

Assessment of the quality of electric power systems containing non-linear loads on the basis of experimental and simulation is of practical importance. To ensure electromagnetic compatibility of non-linear loads with power supply systems, a number of rules limits the amount of "noise" introduced by the receivers for power system - which is why it is necessary to carry out measurements of power quality. The paper presents examples of the results of experimental and simulation research of voltage distortion in the system traction power substation equipped with rectifier circuits. Measurements have been carried out in transformer station 220/15kV on 15kV side. This transformer supplies the 3kV DC traction containing 12-pulse converter.

II. ASSESSMENT OF THE DEFORMATION VOLTAGE TRANSFORMER STATION – MEASUREMENTS AND NUMERICAL RESULTS

As a result of the measurements followed by their digital processing can be determined: eg. harmonic current and voltage coefficient of voltage distortion (THD).

For the supply system with nonlinear load experimental results were compared with the results of computer simulations of the system using the program Microcap.

System has 15kV bus bars supplied from 220kV bus bars (short-circuit power $S_{zw}=600\text{MVA}$) through cable line and transformer of power $S=25\text{MVA}$ (Ynd11, 115kV/16.5kV). There are equipped with two separate bus bars 3kV DC in traction substation.

Each section is supplied by two rectifiers (parallel connection) type PD 12 plus PD16. Each rectifier are supplied by 3-winding transformer TOZ-4400/15 with nominal power $S=4.4/2.2/2.2\text{MVA}$ (Y/y0-d11). Schematic diagram is presented on Fig. 1.

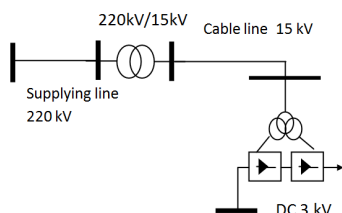


Fig. 1. Schematic diagram of measuring system

Analyzing substation as each nonlinear load generated typical distortion. Distortions generated by 12-pulse rectifier are sources of k -harmonics

$$k = 4n \pm 1 \text{ where } n = 3, 6, 9 \dots \quad (1)$$

and fluctuation of voltage. In this case 11th and 13th harmonic have dominated values (Fig.2,3).

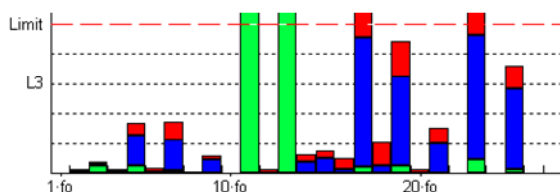


Fig. 2. Measured spectrum of voltage on 15kV bus bar

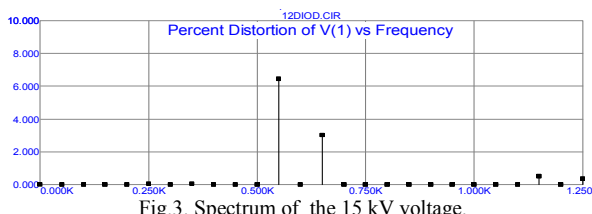


Fig.3. Spectrum of the 15 kV voltage.

Figure 3 presents spectrum of the 15 kV voltage on the basis of simulation experiments done in Microcap.

III. CONCLUSION

Exceeding of permitted levels of voltage distortion is caused by to low value of short circuit power on 15kV bus bars in comparison with power of converter systems (impedance of supply circuit is to high). Distortion of voltage, caused by work of substation is proportional to the load, 11th and 13th harmonics have the main influence on THDV on 15kV bus bars,

In registered 15kV voltage additional harmonics generated by electroenergetics system have been appear.

IV. ACKNOWLEDGEMENTS

This work has been supported from National Science Centre.

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