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SIMULATIONS OF THE REACTIVE POWER COMPENSATION SYSTEM FUNCTIONING OF THE ALTERNATIVE CURRENT MACHINE WITH VARIABLE LEAD USING PSCAD-EMTDC PROGRAM

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ABSTRACT

This paper present the simulation results on reactive power compensation system, which is used on a A.C. machine with variable leads. To demonstrate the efficiency of the reactive power compensation system the simulations were be made in two circumstances: with and without the reactive power compensation system. The simulations were be made using the PSCAD-EMTDC simulation program.

KEYWORDS

Reactive power compensation system, A.C.machine.

1. INTRODUCTION

The three phased systems was projected and realized to functioning under balanced conditions. In these cases all the components, such as generators, transformers and leads have identical parameters on each phase, and voltages and currents three phased systems are symmetric in any section. If one of these elements became nonsymmetrical, the functioning of the whole installation became unbalanced.

The most unfavorable consequence of the unbalanced voltage consist in circulation of supplementary current components which lead to supplementary looses of voltage, parasitical couple on a.c. machine, a growing frazzle, etc.

Another unfavorable consequence consists in reactive power appearance, due to nonzero phase between direct components of currents and voltages.

On a.c. machine the negative effects consist especially in reactive power circulation in three-phased system, which is as higher as the power machine is higher.

This paper present the simulation results of the a.c. machine functioning with variable lead, analyzing three-phased power and the possibility to compensate the reactive power using capacitors battery.

2. THE EQUIVALENT ELECTRIC SCHEME OF THE A.C. MACHINE

To simulate the functioning of the a.c. machine we consider an electric system, which is composed by a three-phased a.c. machine supplied from a three-phase inverter. Because the a.c. machine is a high power machine, the parameters value was chosen as it follows:

$$U_N = 6\,\mathrm{KV} \tag{1}$$

$$P_N = 6\,\mathrm{MW} \tag{2}$$

$$\mathrm{COS}\varphi_N = 0{,}9 \tag{3}$$

$$\eta_N = 0{,}95 \tag{4}$$

With this parameters value it can be computed next electrical parameters value:

$$P = \frac{\mathbf{P_N}}{\boldsymbol{\eta}_\mathbf{N}} = 5{,}26\,\mathrm{MW} \tag{5}$$

$$U_f = \frac{\mathbf{U_{nl}}}{\sqrt{\mathbf{3}}} = 4{,}8\,\mathrm{KV} \tag{6}$$

$$I_f = \frac{\mathbf{P}}{\mathbf{3 \cdot U_f \cdot cos}\,\varphi} = \mathbf{398{,}39}\ \mathrm{A} \tag{7}$$

The a.c. machine has the Y stator connection wrapping, whose mono-phase electrical scheme is presented in figure 1.

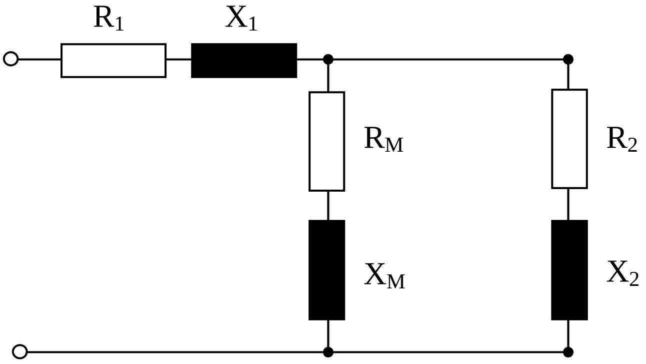


Fig. 1. Mono-phase electrical scheme.

Relations (8) – (13) give the parameter values from figure 1.

In relation (13), *s* parameter represents the slide between stator and rotor fields.

$$R_1 = 1\ \mathrm{m\Omega} \tag{8}$$

$$X_1 = 10\ \mathrm{m\Omega} \tag{9}$$

$$R_M = 1\ \Omega \tag{10}$$

$$X_M = 10\ \Omega \tag{11}$$

$$X_2 = X_1 = \mathbf{10m\Omega} \tag{12}$$

$$R_2 = \frac{\mathbf{R_1}}{\mathbf{s}} \tag{13}$$

Considering that electrical scheme from figure 1 can be approximate by the three-phased simplified electrical scheme from figure 2, is obvious that electrical parameter values depend on the *s* parameter.

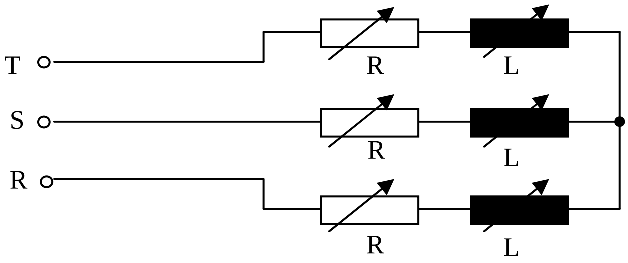


Fig. 2. *The three-phase simplified electrical scheme.*

3. THE ELECTRIC SCHEME OF THE THREE-PHASED INVERTER

The a.c. machine supply is assured from a three-phased inverter whose electrical scheme is presented in figure 3.

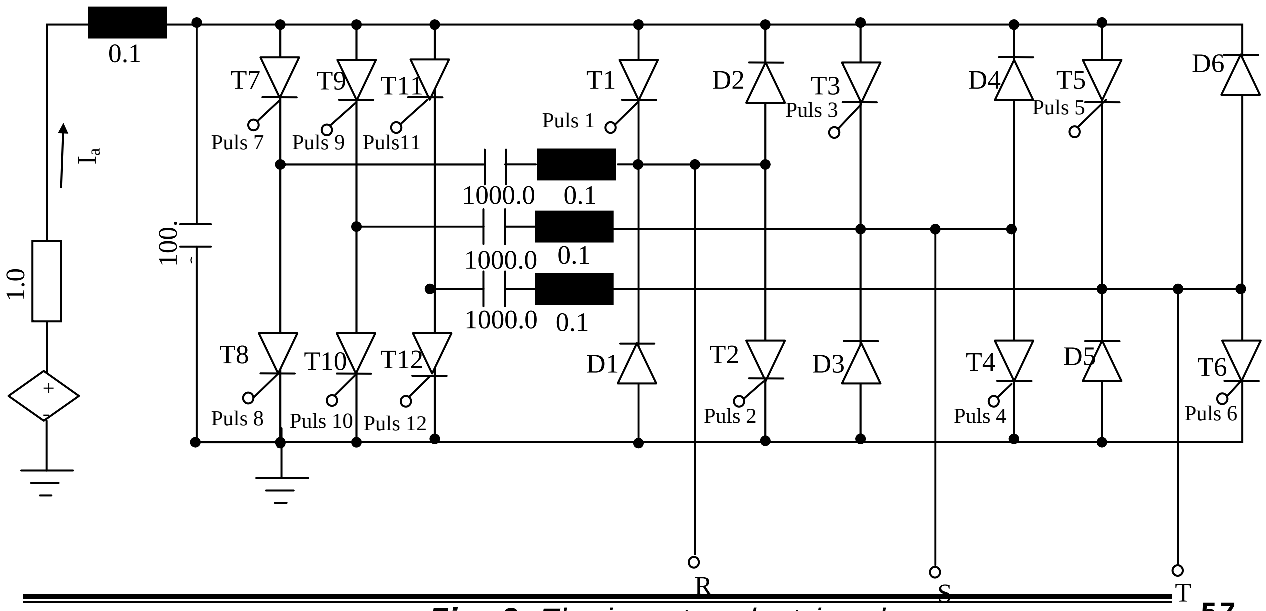
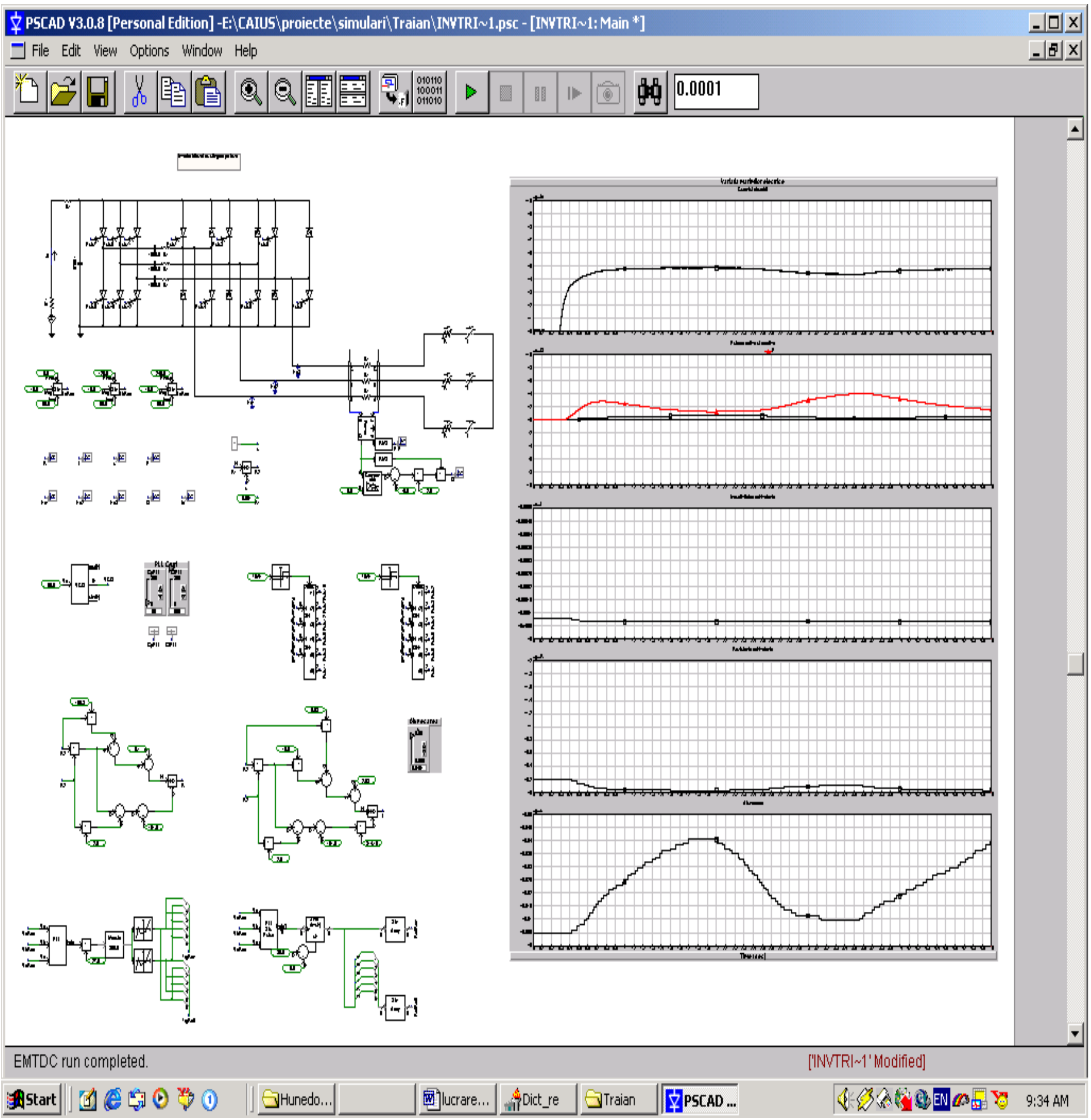


Fig. 3*. The inverter electric scheme.*



EMTDC run completed.

['INVTRI~1' Modified]

Fig. 4. *Simulation results without reactive power compensation system.*

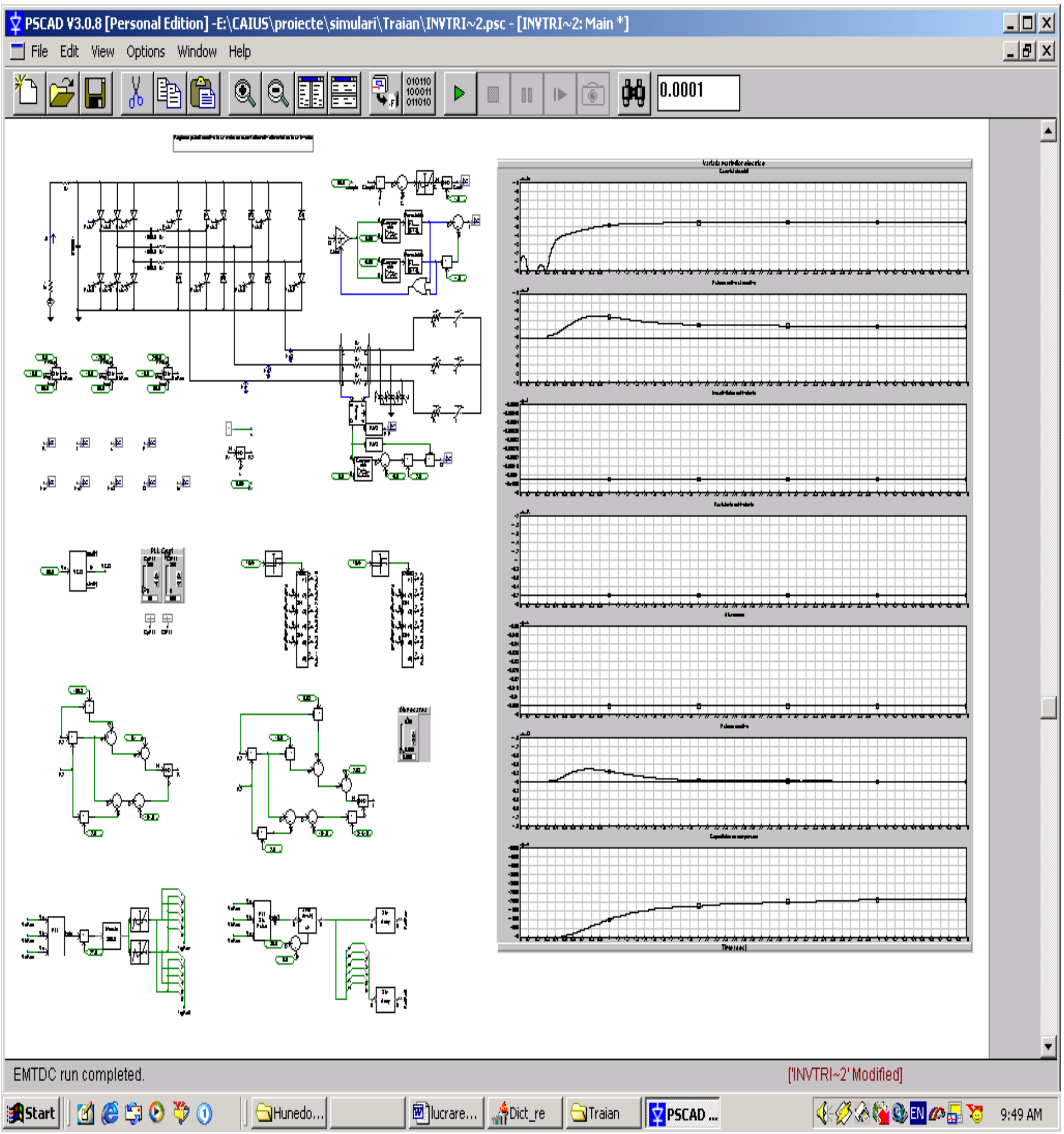


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Fig.5. *Simulation rezults with reactive power compensation system.*

4. THE REACTIVE POWER COMPENSATION ALGORITHM

The results using PSCAD-EMTDC simulation program are shown in figure 4. It can be see that the reactive power values depend on *s* parameter.

To realize the reactive power compensation process was used a reactive power compensation installation, composed from condenser battery. Considering that Q is the reactive power values introduce by a compensation step the control algorithm is:

- If the reactive power value is in –Q to +Q domain the reactive power step compensation does not change;
- If the reactive power value is greater then +Q the next reactive power step compensation will be used;
- If the reactive power value is lower then –Q the previous reactive power step compensation will be used.

The simulation results are presented in figure 5. It can be see that the reactive power is control by the compensation system such as the final reactive power tends to zero value.

5. CONCLUSIONS

The simulations realized by the authors was concerned in two directions. The first consist in verifying by simulation that the values reactive power compensation installation permit to obtain the wanted values of the reactive power step.

The second direction demonstrate that it can be implemented a reactive power control algorithm.

6. REFERENCES

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