The first simulation was performed without change in the TAP, it was observed that the voltage in the secondary side dropped from 0.380 kV to 0.350 kV due to the presence of the load.

For the Fixed TAP test in the primary a percentage of TAP 90% was placed, it was possible to observe in Table 4 that the voltage returned to 0,380 kV. The same procedure was performed for Fixed TAP in the secondary with a percentage of 110%, obtaining the same result. Thus, it can be concluded that the transformer with Fixed TAP was validated.

Table 4 - Test Results with different TAPs

Sem TAP	TAP Primário	TAP Secundário
0,35 kV	0,38 kV	0,38 kV

- Automatic TAP

For the Automatic TAP test, the same system of Figure 6 was used with the same parameters.

Without the automatic TAP the voltage in busbar 2 was from 0.380 KV to 0.350 KV becoming unfeasible. When it was added, it took 3 TAPs with a 2% step to raise the voltage to 0.370. Thus, it can be concluded that the transformer with Automatic TAP has been validated.

5. Conclusion

In this article was proposed a new methodology to model three-phase transformers, in which the magnetizing and neutral branches are included for the different types of connections. This type of method was performed to represent more realistically the electrical system, unlike the other studies that are found in the literature.

The results obtained through the simulations observed the efficiency of the proposed method. The different types of connections converged and there was no increase in computational time of solution.

For future work, convergence in an 18-bar system and the number of interactions required will be studied. In addition, the computational time of the different methods will be compared.

Acknowledgement

We thank the Laboratory of Energy Efficiency (LEFE) of the Federal University of Uberlandia for the support that facilitated the research and the help in the writing of this article. CNPq for financial support.

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