Comparison between ARISTO and DIgSILENT PowerFactory

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Stability is an important issue in electrical power system. As a result, several industrial-grade power system simulator tools are developed in order to estimate the behaviour of the electric power system under certain conditions. Certain details choices regarding modelling and computations have been made in order to guarantee the requirements of the tool. It is interesting to compare different simulators and their performance. In this work the real-time simulator ARISTO is compared with the offline simulator DIgSILENT PowerFactory.

1. INTRODUCTION

In order to guarantee the real-time performance in ARISTO, some choices and simplifications have been made. It is interesting to see if this affects the simulation results and therefore ARISTO has been compared to a more widespread simulator, DIgSILENT PowerFactory. Different results are expected but in order to find out how significant differences are some simulations and tests with different models have been run.

Generally, ARISTO is able to manage the same phenomena in electrical power system, as PowerFactory with the exception of some analysis from PowerFactory which ARISTO cannot perform and vice versa.

2. SYSTEMATIC COMPARISON

Simple models are first used.

The result from the comparison is that frequency is not defined in the same way in ARISTO as in PowerFactory. In the last one the frequency is defined according to machine speeds and the admittances matrix but in ARISTO uses the phase angle as is shown in the equation 1. The definition in ARISTO case makes large changes in the angle cause large changes in the frequency while in PowerFactory the frequency varies softly.

$$f = fo + C \cdot \frac{\theta_1 - \theta_0}{\Delta t} \quad \text{Eq 1}$$

Secondly, the details of the synchronous machine models are compared. One of the most important parameter which is not defined similarly is the subtransient reactance. This parameter is a reactance from the synchronous machine which influences the whole system in the simulations. According to the equation 2, in Power Factory this subtransient reactance is directly defined by X''_d as in the equation 2. However, in ARISTO the parameter subtransient reactance is defined by D which represents the damping windings in the synchronous machine and corresponds to X_D in the equation 2.

$$X''_d = X_l + \frac{1}{\frac{1}{X_a}+\frac{1}{X_D}+\frac{1}{X_f}} \quad \text{Eq 2}$$

Therefore, there is a mechanical damping that affects in PowerFactory which is not defined in ARISTO.

There are also differences in the definition of the components. The controls modules as Voltage regulators, currents limiters, power system stabilizer, etc, are differently defined. In ARISTO all these controllers are available in the model library and it is not possible to change their function. However, in Power Factory thiese controllers can be created freely using block diagrams. In this work the controllers in ARISTO are built in PowerFactory to make a fair comparison possible.

3. SMALL TEST SIMULATION

To check how the differences influence the result a simple two-area system, which is shown in the figure 1, is used and several events have been run.

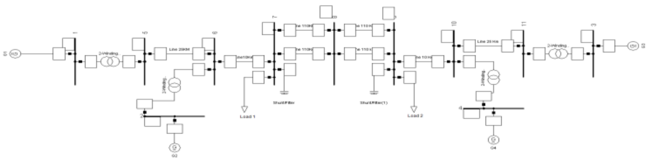

Figure 1

After several tests, it was concluded that different definition in the subtransient reactance gives as result that damping is always less in ARISTO and therefore, the oscillations due to disturbances are larger and the system loses the synchronism earlier in ARISTO than in PowerFactory.

4. LARGE TEST SIMULATION

The large test simulation is developed to see if both simulators can simulate the same behaviour of the system.

The model in this case is Nordic 32, which is shown in figure 2.

In the test the important behaviour which must be represented is the Voltage collapse when one of the generators is tripped. Both simulators must activate the currents limiters at 20 seconds and the tap-changer at 40 seconds. This makes the voltage collapse between 40 to 50 seconds.

The result from ARISTO is the expected one, therefore, it can concluded that as general point this simulator is working properly.

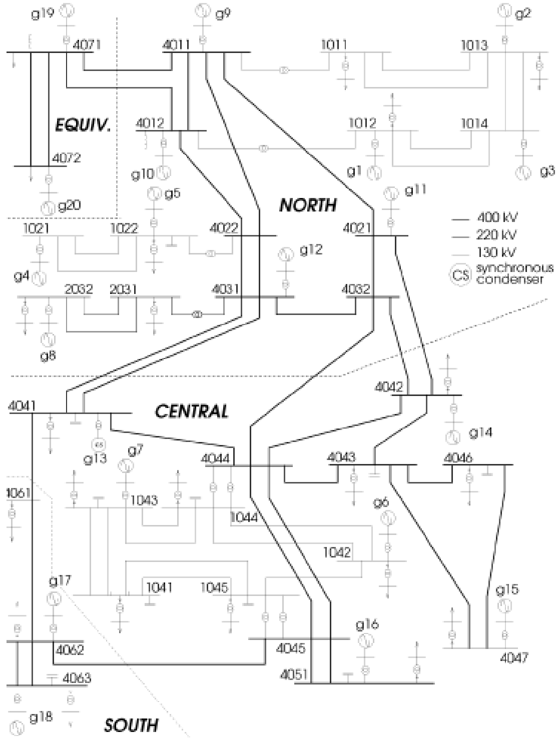

Figure 2

5. SOFTWARE BUGS

There are some bugs that must be fixed: In an electrical power system some quantities have to be fixed to calculate the remaining quantities in the Load Flow,. ARISTO in some cases does not follow this method and therefore, the load flow gives different result and the system starts the simulation with different initial values.

In some cases, also a Not a Number appears in the result. This NAN will cause some errors in the solve process.

According to Kirchhoff laws the sum of the power on one node must be zero. This situation is sometimes not met in ARISTO.

6. CONCLUSION

Some differences have been found but it is important to bear in mind that each simulator is built for different tasks. The differences found are not enough significant from the point of view for which ARISTO is developed.

There are also important bugs that must be fixed. But as general point both simulators are working properly and realistic results are obtained.