

Title of the Group: Numerical techniques for the computation of power systems, from steady-state to switching transients.

WG number: C4.503	Name of Convenor: Jean MAHSEREDJIAN
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Terms of reference

Background: Power system studies using the circuit based approach are performed by applying various assumptions related to the availability of computational methods and data. Several widely used and traditional tools are based on the balanced network simplification and phasor solution. The most precise numerical techniques are related to the full circuit description and detailed waveform computation approach. Such techniques are of "electromagnetic type" and often used for the computation of fast transients (EMT-type methods). Such techniques are now very efficient and can be used for more precise analysis in a wide range of frequencies. Recent works demonstrated also capability to study very large networks. The application requirements of EMT-type methods are continuously escalating. They now include, for example, unbalanced steady-state analysis, fundamental frequency overvoltage studies and electromechanical transients.

Scope: The scope of studies in this WG concerns the advanced numerical techniques for the computations of steady-state, electromechanical transients, fundamental frequency overvoltages and switching transients. Issues related to the computation of power electronics based components are also included. Lightning related issues are not covered specifically by this WG. The primary scope of this WG is the critical assessment of existing numerical modelling and computation techniques for the above mentioned types of studies. It includes an assessment of errors produced by traditional analysis methods, such as balanced networks, usage of sequence networks and fundamental frequency based solutions. EMT-type methods will be used as reference.

The WG will cover numerical methods for the solution of multiphase load-flow problems, steady-state initialization of network studies and time-domain simulation. In addition to offline methods, computation methods and comparisons using real-time implementations are also included. The WG does not specifically target component modelling issues, but computation methods for established models and data. The computation methods include the interfacing of models in solution matrices and circuit nonlinearities. In some cases, however, it may be necessary to revise modelling theories and compare precision. Comparisons will be delivered with accepted benchmarks for practical applications. The establishment of unified (for a wideband range of frequencies) benchmarks is another contribution from this WG. The number of benchmarks will be limited to account for the duration of this WG.

The WG will collaborate with C4.501 ' Numerical Electromagnetic Analysis and Its Application to Surge Phenomena' and C4.502 ' Power system technical performance issues related to the application of long HVAC cables'. In addition, the WG will collaborate with C4.3 on Insulation coordination aspects.

Deliverables and time schedule: CIGRE Guide "Numerical techniques for the computation of power systems, from steady-state to switching transients" will be produced, and the summary of the report may be published in Electra.

Will start from October 2009 and be disbanded by August 2011.

- 1) First year : Survey of numerical computations methods: simplifications, assumptions, detailed representations, solvers and tools
- 2) Second year : Development of error assessment benchmarks, comparisons of methods, unified benchmarks
- 3) Third year : Producing an Electra paper summarizing the above survey and investigation, and a final report to be submitted by August 2011

Other SCs concerned by the work.

Approval by Technical Committee Chairman: Klaus Fröhlich **Date:** 18/08/2010