

PSS[®]SINCAL

Dynamics

Observations in Electrical Networks Involving a Time Range

These calculation methods are used for the investigation of dynamic processes in electrical networks.

The following modules are available:

- Simple Motor Start-Up
- Motor Start-Up
- Stability
- Electromagnetic Transients (EMT)
- Stability Limit

Simple Motor Start-Up

This simplified procedure determines the maximum effects (drops in voltage, equipment overload) of accelerating motors. PSS[®]SINCAL simplifies motor start-up motors by simulating R/X and Ia/In input data that already exist for the asynchronous machine.

Motor Start-Up

This calculation method determines how much power motors require when they start up while taking into consideration the voltage at the motor braces. PSS[®]SINCAL calculates different network parameters (voltages, currents and powers) for each individual time step during start-up.

This means PSS[®]SINCAL motor start-up calculations evaluate load flow and determine motor performance. The voltages from the load-flow calculations are used to determine motor performance. Different motors can be started at different times.

The results are available both in the network diagram and as diagrams.

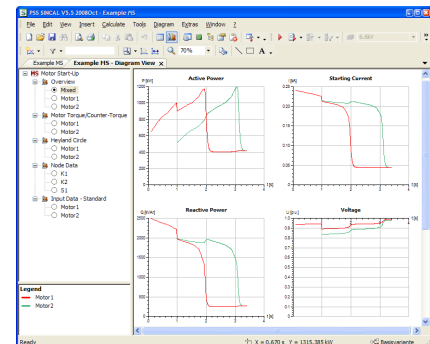


Figure 1: Diagrams for motor start-up calculations

Stability

PSS[®]SINCAL stability calculations analyze the behavior of electrical networks when there are malfunctions or disturbances. A power system is stable, if it returns to a steady-state or equilibrium operating condition following a disturbance.

To assure network stability, the following criteria need to be checked in detail:

- Voltage stability
- Rotor angle stability
- Transient stability
- Rotor angle swing

PSS[®]SINCAL's calculation module for stability has been developed precisely to check these criteria. This calculation module is based on the PSS[®]NETOMAC program package, one of world's leading programs for observing all kinds of dynamic procedures in electrical networks.

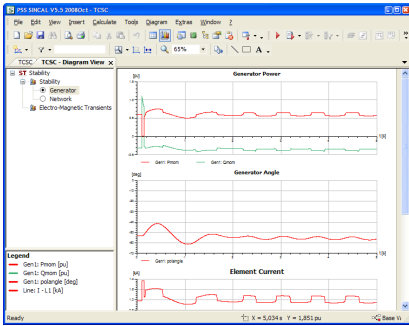


Figure 2: Results of the stability calculations

In stability calculations, the network is only simulated with complex impedances. Controllers and machines are, however, modeled as differential equations. The examined system is simulated symmetrically.

In order to consider unsymmetrical faults in addition to symmetrical faults such as three-phase short circuits, PSS®SINCAL uses symmetrical components (positive-, zero- and negative-phase sequence) to create a universal disturbance scenario. The faults in the network and the associating switchings can be modeled in detail.

This calculation module is used for investigations for which the envelope curves of the characteristic values are sufficient results.

The modeling for networks and machines being investigated can be as complex as you want, i.e. even networks with thousands of nodes and hundreds of machines can be investigated without any problem. So you can recreate controller behavior for equipment, PSS®SINCAL provides you with a controller database containing the various predefined controllers:

- IEEE standards
- Excitation systems

- Turbine governors
- Power System Stabilizer (PSS)
- PSS®E controller models
- Generic wind models

"Block-Orientated Simulation Language" (BOSL) or a "Graphical Model Builder" (GMB) can be used to include user-defined controller structures. For detailed information on GMB, please see the appropriate informative brochure.

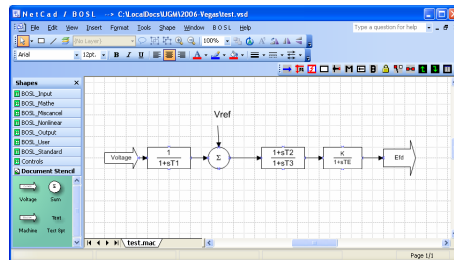


Figure 3: Graphical Model Builder on Visio-Basis

Electromagnetic Transients (EMT)

The Electromagnetic Transients (EMT) let you use differential equations to model networks, machines and controllers.

It offers a complete solution for all electromechanical and electromagnetic phenomena, including unsymmetrical and non-linear processes.

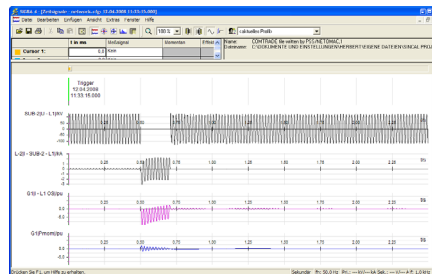


Figure 4: Analyzing EMT results with SIGRA

The main field of application is in designing power system equipment while taking

transient phenomena into account. An example for this is determining valve load for a static compensator during and after network short circuits. You can even calculate complex electromagnetic functions in connection with HVDC transmission and FACTS and, for example calculate intermediate harmonics with HVDC transmission.

Stability Limit

This simulation procedure is based on stability calculations used to check whether the network will remain stable after a fault. User-defined limits for minimum and maximum rotor angle of synchronous machines are used for this.

PSS®SINCAL varies the final time for the fault and performs one stability calculation after another. PSS®SINCAL automatically monitors the rotor angles of synchronous machines.

As soon as one of the two angles has been exceeded at a synchronous machine, PSS®SINCAL uses final time of the fault observation as a limit for stable network operations.