Eletrobras
Cepel

1974 • 2014
40 anos

Electrical Networks Department

Electrical Networks

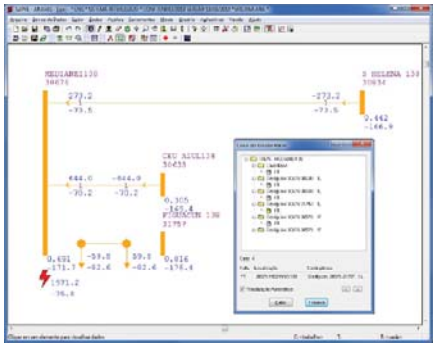
ANAFAS | Simultaneous Fault Analysis

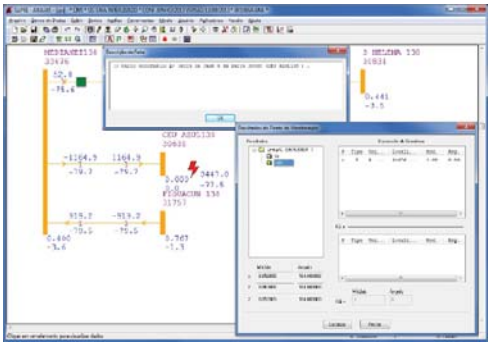
ANAFAS is a short-circuit calculation software that covers a wide range of automated fault simulations. Its output reports are guided by fault points or monitoring points. Additional features include circuit breaker rating analysis, network equivalent calculations, bus short-circuit sensitivity analyses and short-circuit level evolution reports.

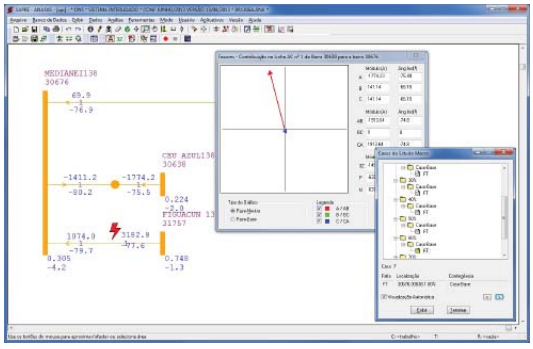
ANAFAS is integrated to SAPRE, which has a one-line diagram editor, giving direct interaction with diagram elements and easy visualization of results.

ANAFAS aided analysis verifies short-circuit current ratings, gives access to grid studies and also assists in fault location and protection grading of transmission lines. Its equivalent networks are useful in electromechanical and electromagnetic transient studies.

ANAFAS is widely used by the Eletrobras System, ONS (Brazilian ISO), state-owned Brazilian Energy Research Company (EPE), Brazilian Ministry of Mines and Energy (MME), Brazilian Electricity Regulatory Agency (Aneel), power transmission companies, universities and electrical engineering consulting companies. The short-circuit data files of the Brazilian National Interconnected Power System (SIN) for use with ANAFAS are available on the ONS and EPE websites.







Contact

Research, Development and Innovation Directorate
Electrical Networks Department
Phone **55 21 2598-6235**
Fax **55 21 2260-6451**
anafas@cepel.br
www.dre.cepel.br

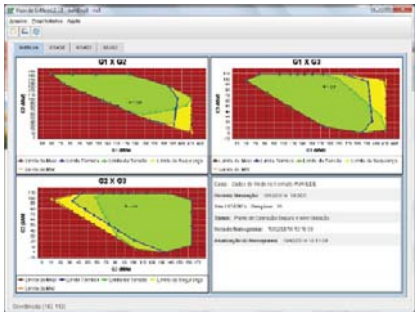
Eletrobras
Cepel

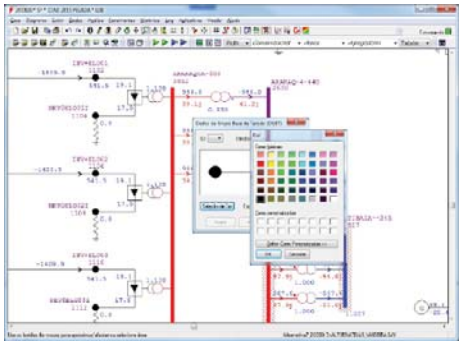
Electrical Networks

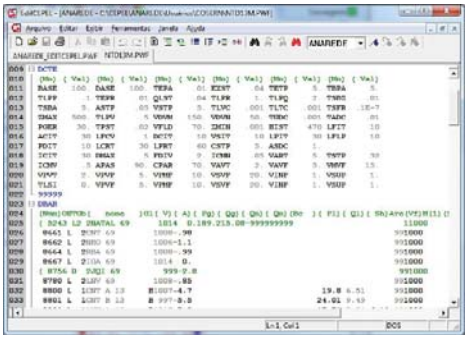
ANAREDE | Power System Network Analysis

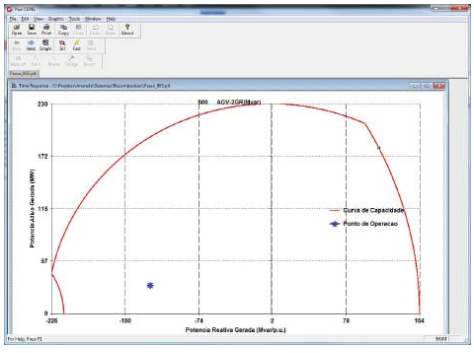
ANAREDE is a software suite for steady-state power system analysis that includes modules for power flow calculation, network equivalents, contingency analysis, voltage and line flow sensitivity analysis and voltage security analysis. The most recent developments include a load curve model, individual equipment, bus voltage control through banks of switchable capacitors / reactors, special features for the evaluation of restoration plans, algorithms to detect control conflicts and static security assessment of large power systems. Its powerful graphical interface, coupled with the auxiliary programs FormCepel, PlotCepel and EditCepel, makes user interaction friendly, fast and efficient.

ANAREDE is the most widely used computer program in the Brazilian electricity industry. Among its users are Eletrobras, ONS (Brazilian ISO), the Energy Research Company (EPE), the Ministry of Mines and Energy (MME), the National Electricity Regulatory Agency (ANEEL), state and privately owned generation, transmission and distribution companies, universities and independent consultants. Data files on ANAREDE format are available for download at the websites of some of the previously mentioned institutions.









Contact

Research, Development and Innovation Directorate
Electrical Networks Department
Phone **55 21 2598-6235**
Fax **55 21 2260-6451**
anarede@cepel.br
www.dre.cepel.br

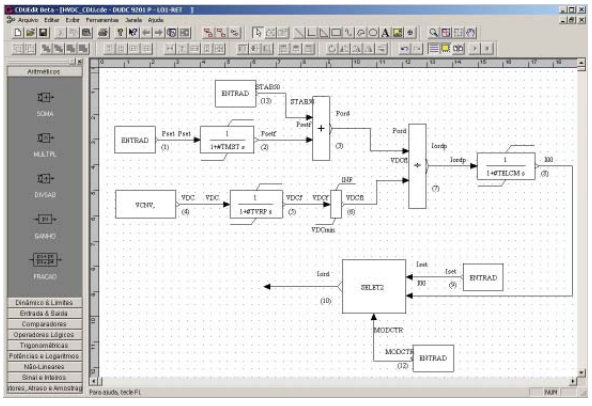
Eletrobras Cepel

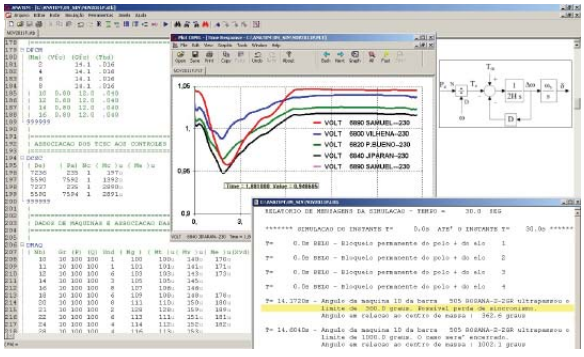
ANATEM | Analysis of Electromechanical Transients

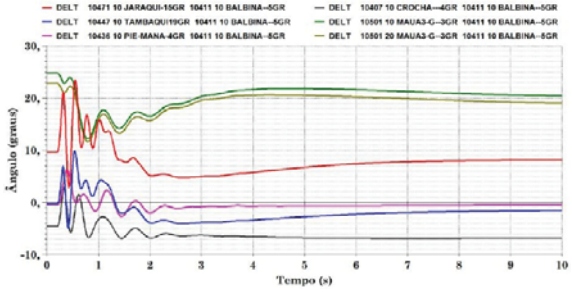
ANATEM is a software for transient stability simulation of large scale power systems. The component models are precise and the control systems may be simulated using User Defined Controllers (UDC) to model the dynamic characteristics of generic controllers with flexibility and precision. Complex components such as HVDC links and FACTS devices can also be used.

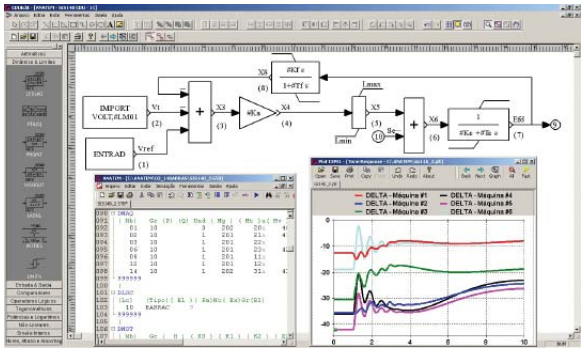
ANATEM is very reliable, robust and efficient. It communicates with the computational program ANAREDE (Power System Network Analysis) and with the auxiliary programs iANATEM (graphical interface for editing dynamic data and start execution), PlotCepel (graphical visualization of results) and CDUEdit (graphical user interface for editing and visualization of user defined controllers).

ANATEM is the most commonly used software for the dynamic electromechanical analysis of the Brazilian National Interconnected Power System.









Contact

Research, Development and Innovation Directorate
Electrical Networks Department
Phone **55 21 2598-6235**
Fax **55 21 2260-6451**
anatem@cepel.br
www.dre.cepel.br

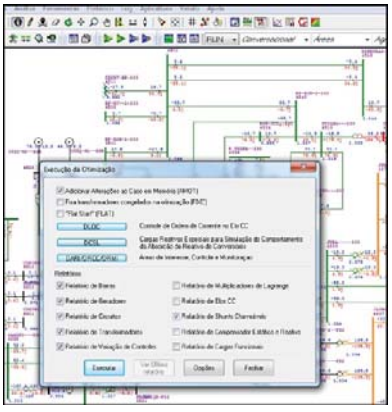
Eletrobras Cepel

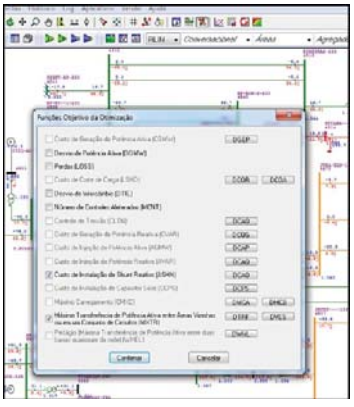
FLUPOT | Optimal Power Flow

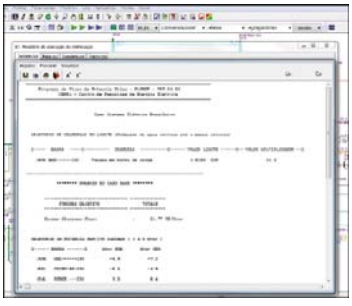
The Optimal Power Flow Software, FLUPOT, aims to determine the operating state of the power grid in a steady-state that optimizes a given objective function and satisfies a number of physical and operational constraints. FLUPOT uses efficient algorithms of nonlinear programming and has flexibility in the choice of the objective functions, controls and restrictions to be used in the optimization process.

FLUPOT can also apply a set of contingencies in the network, called Optimal Power Flow with Security Constraint. In this mode, the program determines a solution that optimizes the objective function and meets a number of physical and operational constraints for both the base case and for each contingency case, taking into account the controls that can be changed for both of them. FLUPOT also has solution strategies for difficult cases based on Lagrange Multipliers.

Among the many studies that use FLUPOT the Transmission or Sub-transmission System Planning and the Short-term Operation of Power Systems are the most important. Currently, the integrated version of SAGE (Open Energy Management System) software is used to optimize real-time operations. FLUPOT is also integrated with the software ANAREDE (Power System Network Analysis), and among the many benefits of this integration the studies in the use and conservation of equipment individually as well as in the switched-off state should be noted.







Contact
Research, Development and Innovation Directorate
Electrical Networks Department
Phone **55 21 2598-6235**
Fax **55 21 2260-6451**
flupot@cepel.br
www.dre.cepel.br

Eletrobras Cepel

Electrical Networks

FORM, PLOT & EDIT

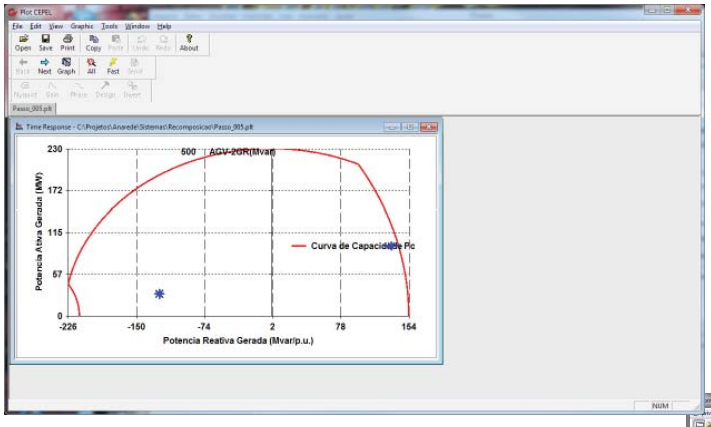
| Auxiliary Programs

FormCepel, PlotCepel and EditCepel are auxiliary programs developed and specially conceived by Cepel to increase productivity in operational and planning programs of electric power systems.

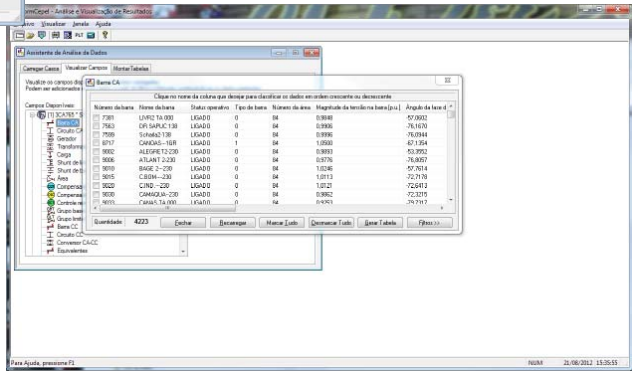
FormCepel creates tables, combining input data and results that can be easily filtered to customize reports. Tables comparing data and the results of hundreds of cases allow the user to identify the critical ones. These tables can be transferred to Excel and other applications where they can be freely manipulated by the user.

PlotCepel is a versatile tool for the visualization of results in a graphical form. Any combination of curves can be applied and the results can be analyzed at different levels of detail.

EditCepel is a custom text editor for the preparation of data files used by the operational and planning software for power systems developed by the Electrical Networks Department of Cepel. Its ease of use and the availability of features to reduce errors facilitate the preparation and handling of large data files, making it a valuable tool for the Cepel power system analysis software.



Picture 1 - PlotCepel



Picture 2 - FormCepel

Contact

Research, Development and Innovation Directorate
Electrical Networks Department
Phone **55 21 2598-6235**
Fax **55 21 2260-6451**
formcepel@cepel.br
plotcepel@cepel.br
editcepel@cepel.br
www.dre.cepel.br

Eletrobras
Cepel

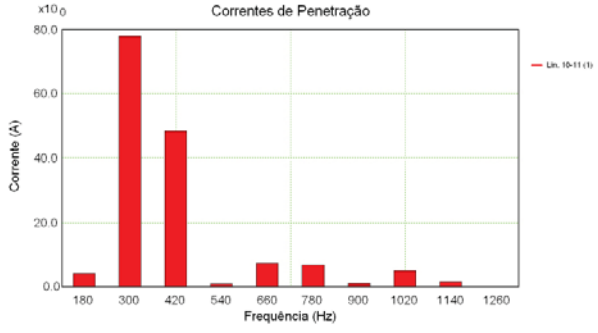
HarmZs | Harmonic Analysis

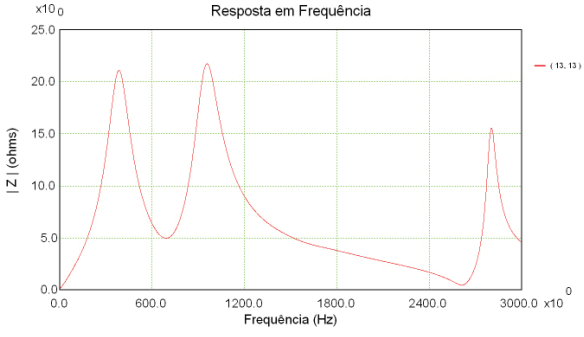
The HarmZs software is designed to perform harmonic studies in power systems. This program carries out two kinds of analyses: conventional and modal.

The modal analysis is able to acquire system information such as time simulation or frequency response that is difficult to be obtained by conventional methods. This information includes the natural oscillation modes (system resonances) as well as the equipment that is chiefly responsible for these modes. This data can then be used to improve the performance of the harmonic system.

The conventional analysis computes harmonic voltage distortion, harmonic currents flowing through the system, frequency responses of different types of transfer functions (impedances, admittances and gains) and sector diagrams of impedance and admittance.

Nowadays HarmZs is widely used to carry out harmonic studies involving the connection of non-linear loads to the national grid. Such studies are supported by the close ties between HarmZs and the ANAREDE (Power System Network Analysis) and ANATEM (Analysis of Electromechanical Transients) data files. After reading these files, HarmZs extracts network component data concerning shunt elements, transmission lines, transformers, loads and generators (armature resistance and sub-transient reactance). Also harmonic studies, such as non-linear load connections to the national grid, involving several network topologies, load levels, load models and contingencies can be speeded up and made automatic using the "batch" tool available within the HarmZs software.





Contact
Research, Development and Innovation Directorate
Electrical Networks Department
Phone **55 21 2598-6235**
Fax **55 21 2260-6451**
@cepel.br
www.dre.cepel.br

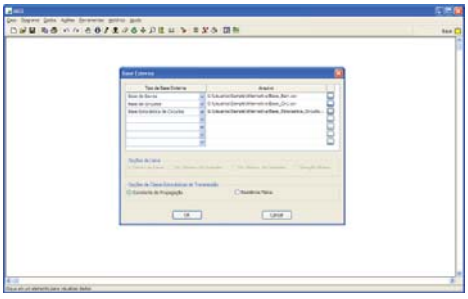
Eletrobras Cepel

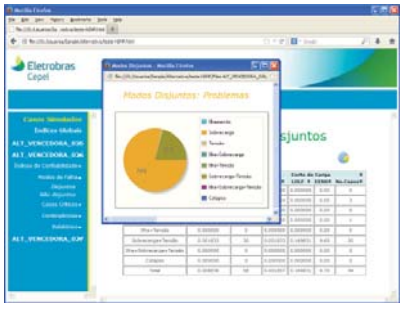
Electrical Networks

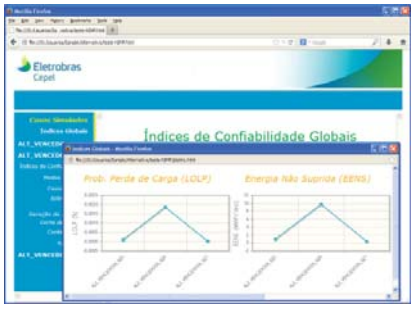
NH2 | Probabilistic and Reliability Analysis

The NH2 software is a reliability assessment tool for bulk power systems. The software is used by planners and operators, and guarantees adequate levels of reliability as it measures system risk under different planning alternatives. Numerical methods and models to simulate generating units and transmission circuit outages are calculated and performance indices to allocate economical resources throughout the system, appropriately, are also carried out. Failures are modeled through a full AC network model, and during contingency analysis the automatic remedial procedures are based on a non-linear optimal power flow method. The software enables both deterministic and probabilistic reliability assessment, providing two methods for this evaluation: contingency enumeration based on a user-defined contingency list and a non-sequential Monte Carlo simulation.

The NH2 software is compatible with the ANAREDE program, and is considered to be a complete tool for the reliability assessment of bulk power systems. Currently it is used by universities and several companies in Brazil, including Eletrobras, ONS (Brazilian ISO) and Energy Research Company (EPE). NH2 software can read system data in ANAREDE files, and additional data in Excel (c) CSV files. Also it can write HTML reports, enhancing easy input and output of data for analysis. Easy access to data of the Brazilian power system helps run the software effectively.







Contact

Research, Development and Innovation Directorate
Electrical Networks Department
Phone **55 21 2598-6235**
Fax **55 21 2260-6451**
nh2@cepel.br
www.dre.cepel.br

Eletrobras
Cepel

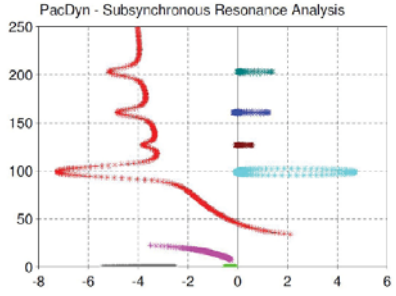
Electrical Networks

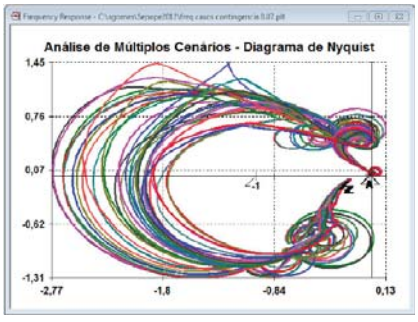
PacDyn | Analysis and Control of Oscillations in Power Systems

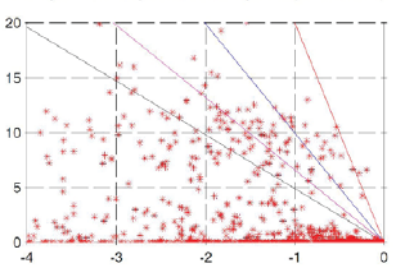
PacDyn is a production-grade software package for the analysis and control of small-signal stability in large power systems. PacDyn uses state-of-the-art algorithms for the calculation of selected eigenvalues, dominant poles and zeros of scalar and multivariable transfer functions, transfer function residues, linear time response and frequency response plots, subsynchronous resonance and torsional interaction problems. It has been used in stabilization studies of large interconnected systems, including some encompassing several countries. An important feature is its ability to read various network and dynamic data file formats, giving easy integration to other power system analytical packages, such as ANAREDE, ANATEM and PSS/E.

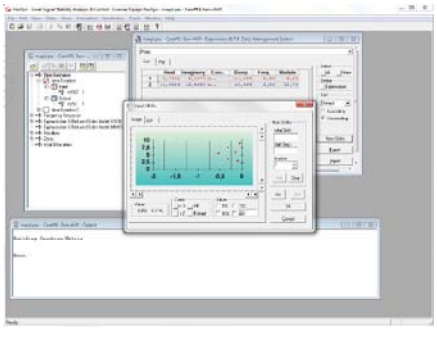
The PacDyn project has been a fertile ground for the development of small-signal analyses, damping controller design methods and numerical linear algebra algorithms that are described in detail in various publications referenced in the manual.

Currently PacDyn may be used as an integrated tool for ANATEM. PacDyn may be started directly from the ANATEM user interface and the same data files are used. Together, they form a comprehensive tool for dynamic studies. Features such as Multiple Scenarios facilitate the automatic computation of several cases in a single run.









Contact

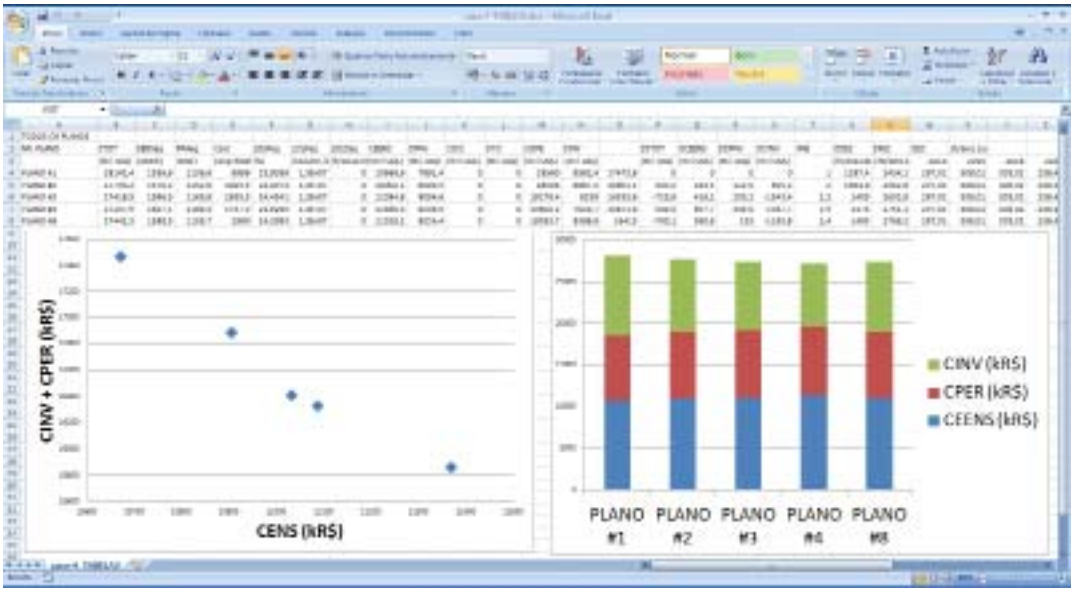
Research, Development and Innovation Directorate
Electrical Networks Department
Phone **55 21 2598-6235**
Fax **55 21 2260-6451**
pacdyn@cepel.br
www.dre.cepel.br

Eletrobras
Cepel

PLANTAC | Transmission Planning with Reliability-Worth

Aimed at the multi-year probabilistic planning, PLANTAC assumes a transmission plan that has been prepared by the user (reference plan) and takes into account its Reliability-Worth. Through AC probabilistic reliability analyses, the software tries to translate the costs and benefits associated with each expansion alternative into economic terms. PLANTAC uses the CEPEL software NH2 as the computational kernel for system reliability processing.

A transmission reference plan prepared by the user based on deterministic criteria can be improved with probabilistic reliability. PLANTAC evaluates changes to the reference plan by comparing them to a large number of alternative plans that are created automatically. The cost-benefit analysis can help rank the best alternative plans, the best reinforcement candidates and the best moment to be included in the multi-year planning. In addition to the annual cash-flow, detailed information is listed for each alternative plan, including the Economic Merit Index, reliability indices, power losses, investment costs, etc. Other features of PLANTAC are: parallel execution in multi-core computers; multi-criteria decision aid technique (AHP); specific quality indicators for sub-transmission systems and a long term planning module.



Contact
Research, Development and Innovation Directorate
Electrical Networks Department
Phone **55 21 2598-6235**
Fax **55 21 2260-6451**
plantac@cepel.br
www.dre.cepel.br

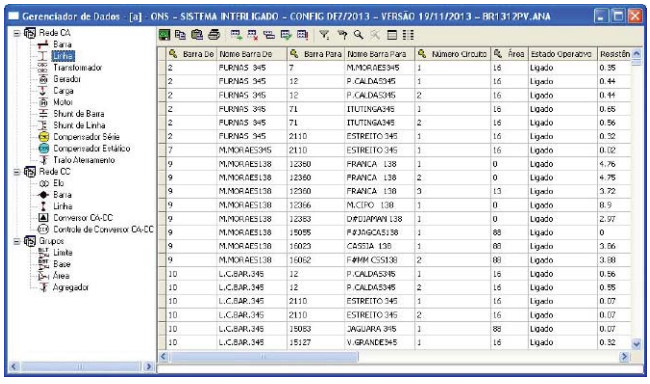
Eletrobras Cepel

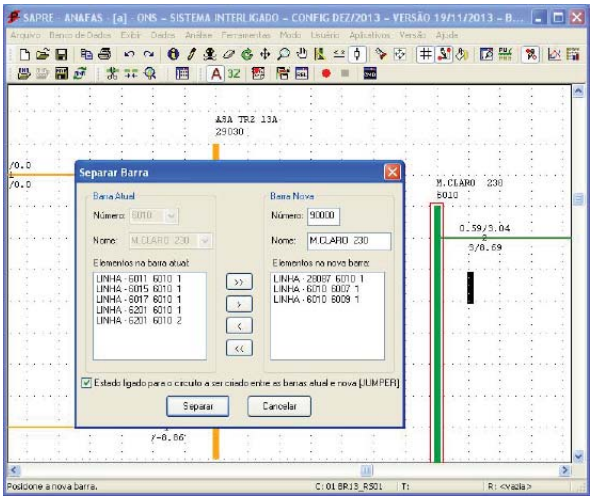
Electrical Networks

SAPRE | Analysis and Design of Electrical Networks

The System for Analysis and Design of Electrical Networks (SAPRE) is an integrated environment for the operation and planning of power system analysis software. CEPEL software is gradually being integrated into this environment of data sharing under a graphical user interface. SAPRE is integrated to SAGE (Open Energy Management System) and is an ideal study environment.

SAPRE is compatible with leading database management systems. It enables the integration of software for the analysis of system networks using a common and expandable database, which is linked to an equally scalable context sensitive graphical user interface. The organization of the database allows electrical studies to be carried out with more security against undesired data modifications. Also, it provides different views for the user, depending on the Run mode selected.





Contact

Research, Development and Innovation Directorate
Electrical Networks Department
Phone **55 21 2598-6235**
Fax **55 21 2260-6451**
sapre@cepel.br
www.dre.cepel.br

Eletrobras Cepel

Eletrobras
Cepel

1974 • 2014
40 anos

Electrical Networks Department