The Solutions Provider

RTPS
REAL TIME POWER SIMULATOR

Automation & Supervisory Control for Electric, Transit & Water Utilities since 1960

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1 INTRODUCTION

Real Time Power Simulator (RTPS) plays an important role in system operation and control in a power system. RTPS has a host of network computation functions, such as state estimation, load prediction, optimal power flows, reactive power control, voltage control, and contingency analysis. Real Time Power Simulator (RTPS) is an automation system that collect energy measurement data from the field and making it available to users through graphics, online monitoring tools, and energy quality analyzers, thus enabling the management of energy resources. The SCADA system forms the heart of RTPS and performs data acquisition, updates of the system status through alarm processing, updates the user interface, and executes control actions when its required.

QEI offers the entire ADMS system (Advanced Distribution Management System) platform, which includes the integrated systems SCADA, DMS, OMS, and GIS.

2 UTILIZATION MODES

Simulation Mode: The RTPS only receives data from the SCADA and does not return it at the request of the user. Operator can make alterations to the modeling or to the data received in real time to make simulations, focused on operational planning.

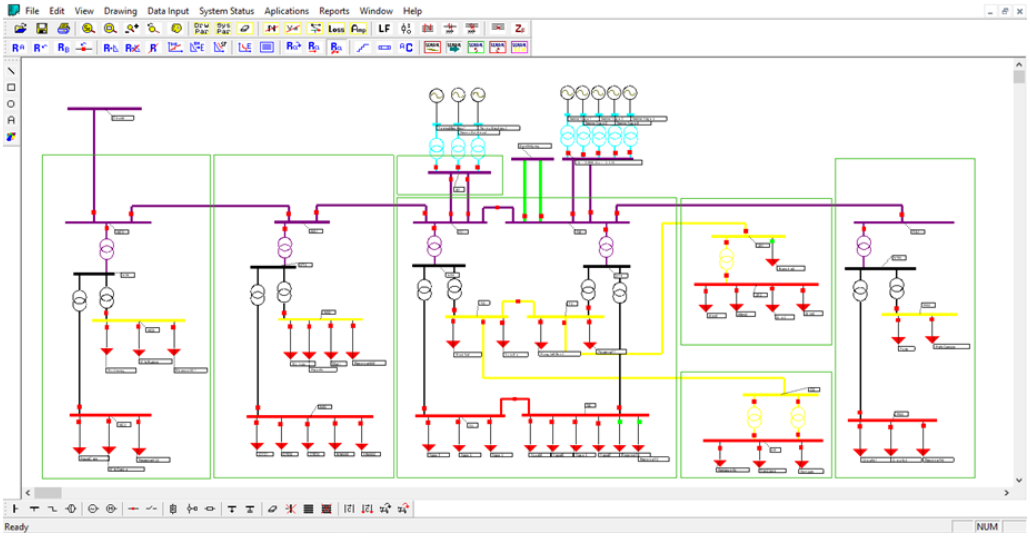
State estimation mode: Data is received from SCADA regularly. State estimation of the variables not read by SCADA are done by means of the algorithm of state estimation, power flow, neural networks, and other auxiliary algorithms, the results of the simulations are sent to SCADA.

Operator Training System (OTS) Mode: RTPS can be a replacement of the real network, where the real situations can be simulated, with the security of not doing operations on the electrical infrastructure. RTPS cab also used use to allow the instructor to make improvised changes, during training, by operating the elements in the single-line diagram.

3 RTPS FUNCTIONS

3.1 Topological processor

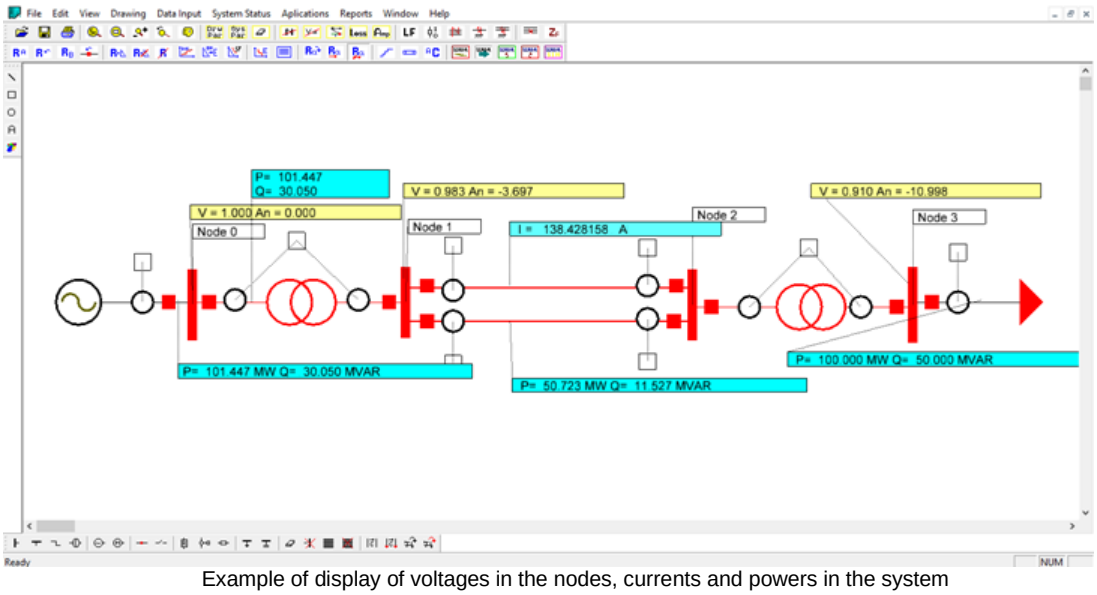
RTPS uses an extremely fast network tree path algorithm with instant response, more than 100,000 nodes are processed in less than 0.9 seconds. The topological processor is used internally in all analysis and optimization applications



Example of an electrical network differentiating tensions by colors

3.2 Power Flow

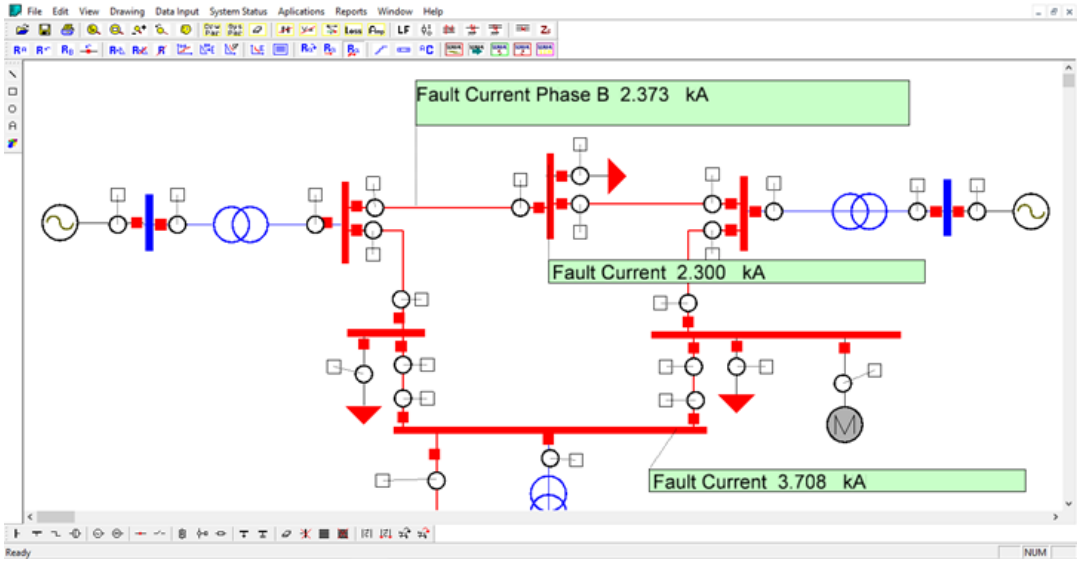
Power and current flows can be determined in transmission lines and power transformers. The Power Flow module will let the user know the load data and power injections in the system. The user can perform operations such as opening or closing a breaker, raising or lowering a Tap of a power transformer or modifying the dispatch of a generator, immediately the displayed values change according to the electrical impact of the operation.



Example of display of voltages in the nodes, currents and powers in the system

3.3 Short Circuit Analysis

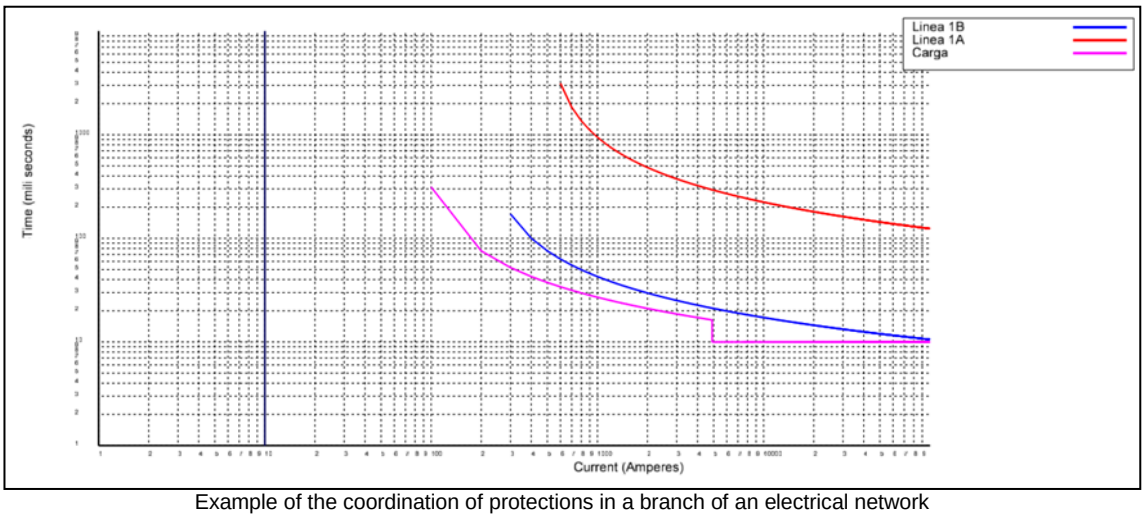
Different types of failure can be simulated (three-phase, single-phase, two-phase, and between phases) with or without fault impedance. Short circuit analyzes are used to adjust the system protections. Short Circuit Analysis provides the levels of short circuit in specific points and the contributions of the electrical branches to the short one.



Example of visualization of the current of different types of bus and line failure.

3.4 Coordination of Protections

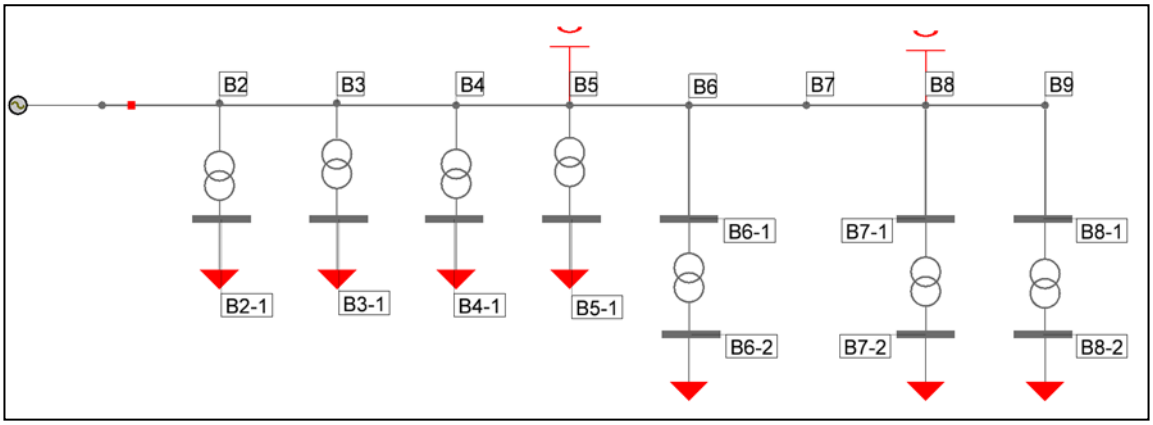
The protection coordination module allows to use the results of the short circuit analysis to simulate the operation of the relays of the system, and then adjust and coordinate the protection system.



Example of the coordination of protections in a branch of an electrical network

3.5 Optimal location of capacitors

The Optimal Location of Capacitors performs reactive compensation studies automatically, considering specification made by the user. This module will find the optimal points in the power system for losses reduction and calculates the capacitance of each capacitor bank, a report is produced suggesting the connection points of the capacitor banks, the capacity of each and the benefit in terms of active power losses.



Example optimal location of capacitors

3.6 Reactive control

The Reactive Control is done by adjusting optimal points of system operation, moving Taps of the power transformers, and connecting or disconnecting existing capacitors banks. A genetic algorithm is used to determine the positions of the Taps and the capacitors to be connected or disconnected. A report is created with a summary of the operation point before and after the optimization and the changes suggested by the software.

3.7 Optimal Power Flow

The lower and upper voltage limits are taken into account so they are never violated. A parametrizable genetic algorithm is used, where the user can determine the cost of losses, the number of generations, the size of the population and voltage limits. To use the optimal power flow for each generator, a cost function is assigned, and operational limits are parameterized (minimum active power generated, maximum active power generated, minimum reactive power generated, maximum reactive power generated).

3.8 Contingency Analysis

A contingency is a situation where one or more elements of the network are lost, for example the opening of a line or transformer. These contingencies are analyzed to determine operating solutions that generate the least impact on the system avoiding overloads and stability losses.

3.9 State estimate

After acquiring the data, a computational tool known as state estimation (SE) is used, which is responsible to process these raw data that often contains errors, and make them credible and available to all others applications. SE acts as a filter in smoothing out statistically small errors and suppresses any gross errors caused by the inadequate operation of the data acquisition system.

3.10 Load Shedding by Power limit

The application will allow to identify in advance the breach of a limit in an active power flow for a period of time, this limit is established by the user on an electrical element, and take actions of disconnection of the authorized loads to be shed in order to avoid the violation of said flow.

3.11 Operator Training System OTS

This function allows to train SCADA personnel in an operating environment with real conditions, but simulated. OTS is a tool that allows the instructor to design scenarios where sequences of events are scheduled, which can be executed automatically.

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