



PRODUCT DESCRIPTION

ENRiCO

(Electric Network Reliability and Ownership Cost Optimizer)

Introduction

In response to user demand from clients in the Power Transmission and Distribution industry, Clockwork Solutions announces its new SPAR™-based application, ENRiCO™, created to provide easy-to-use, comprehensive availability analysis for power distribution networks and substations.

The Industry in Brief

Power plants produce energy which is distributed to consumers via a supply system. The supply system comprises three parts:



Generation – to create super-high voltage in order to decrease transmission losses in long electricity lines.

Transmission – to reduce super-high voltage into high voltage near distribution locations.

Distribution – to further decrease high voltage into medium and low voltage at locations close to consumers.

Each node in the distribution network is a substation. Substations include transformers to convert voltages, switching yards to make connections between inlet lines (sources) such as high-voltage lines and generators, and outlet lines (loads) to distribute the power to the downstream network or directly to consumers. Substations are numerous and have a vital visible role in the power distribution network.

Substation availability defines the consumers' access to the power supply. The probability of supplying electric power to consumers and the outage frequency are mainly determined by substation availability. For electricity companies, the cost of non-supply time to consumers, customer minutes lost (CML), is good reason to invest to improve the performance of substations.

Failures in substations often propagate along the network and may cause severe damage both to customer machinery and to substation equipment. In some circumstances, failures may even cause damage to facilities in generation plants and might expose workers to dangerous situations. Therefore, the design of substations is of extreme importance for economic and safety reasons.

The Complexity of the Problem

The structure of substations is complicated and requires a balance between two conflicting requirements. On one hand, in order to guarantee the supply of electricity, redundancy can be added resulting in more paths between inlet lines (sources) and loads thus lessening the reliance of the network on any single path. On the other hand, more redundancy necessitates more components and thus more potential for failures with the cascading effects of these failures on other components, consumer equipment, and sources.

The design of substations and distribution networks is complex. Accurate computer modeling of substations and their participation in distribution networks is exceedingly so. Furthermore, creating a computer model that can analyze substation performance is an extremely difficult, time-consuming, and recurring chore that requires highly trained

personnel. For example, due to the complex switching actions with disconnected switches and normally-open circuit-breakers that can take place in regular operations, analyzing outages resulting from failures in substations for practical substation configurations is difficult. Accurate analysis must also consider the complex reconfiguration procedures employed to recover energy supply following component failures and protection relay responses. There is strong interest and need for a complete and accurate, performance modeling solution. However, until now, the range of existing tools and applications has provided partial solutions at best.

Introducing ENRiCO

While SPAR™ is Clockwork's comprehensive suite of modeling and performance measuring applications used in a variety of industries, ENRiCO is the application of SPAR™ to the problem of modeling and measuring the reliability of the electricity distribution network. Based on SPAR™ technology, ENRiCO greatly simplifies the modeling task and provides the user with the necessary objects and facilities to simulate the complex interactions of the substation and distribution network.

ENRiCO provides the objects and embedded logic necessary for modeling any type of substation and network configuration from simple to very complex. Employing a Windows-style GUI and familiar-looking icons, standard IEC symbols, ENRiCO enables the user to build a complete computer model of the distribution system on a single computer screen. Each icon is loaded with industry component-specific characteristics and logic thus simplifying the creation of the model, the inputting of the necessary data, the running of the simulation, and the outputting of results.

While solving intricate and complex problems, ENRiCO's technical requirements are minimal. ENRiCO runs on a Windows-based PC with a Pentium processor, at least 32MB of memory, and 50MB of available disk space.

Learning ENRiCO is easy for technical people familiar with the industry. Clockwork offers one-day training classes in any of our training sites or at customer premises. At the end of the training, the modeler is prepared to model his distribution network and to enter the input data necessary to run the simulation.

As with all SPAR™-based applications, ENRiCO is supported by Clockwork Solutions. We maintain the application and provide advice as part of our maintenance policy. Clockwork modelers are always available for consultation and support.

A Tour of ENRiCO

Substations and Network Components

ENRiCO considers the most common components of substations: sources (inlet lines, generators, upstream substations, etc.), loads (customer machines, downstream substations, etc.), busbars, circuit-breakers, fuses, transformers, disconnectors, cables, splices, surge arrestors, capacitors, grounding switches, etc. ENRiCO also provides the means for the user to define additional components and groups of components.

The Electric Behavior of the Substation

ENRiCO considers the electric behavior of the substation taking into consideration such items as the protection circuit-breakers, the isolation of failed components, switching-times, and so on. The logical elements deal with the following main failure modes:

- **Regular failure**
 - Non-Severe-Events (e.g., inadvertent circuit-breaker opening)
 - Circuit-breaker Fail-to-Open
 - Circuit-breaker Fail-to-Close
 - Isolatable and Non-Isolated Components
 - Undetected failures (e.g., failure of an open circuit-breaker)

The Graphic User Interface

ENRiCO employs the familiar Windows graphic metaphor to represent the physical properties of the network to the user. It enables the user to describe the network and its characteristics by means of an easy-to-learn-and-use library of icons and embedded logic.

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