Software tool for planning the automation of MV feeders in Enel distribution network

Gino Di Minni  
ENEL ICT  
Italy

Christian Noce  
ENEL Distribuzione  
Italy

Angelo Ovarelli  
ENEL Distribuzione  
Italy
Objective of the paper

To present the software tool designed and used by Enel Distribuzione to assist the planners in the projects making of the network automation and to permit the management of all the involved processes
Presentation

- Introduction
  - Network automation philosophy
  - Software tool description
  - Experience and main benefits
  - Conclusions
Introduction

Enel Distribuzione planned important investments to improve the continuity of service to face the target levels established Italian Regulator.

With reference to the reduction of the number and the time duration of interruptions, great improvement can be obtained by an optimal planning of the Network Automation System (NAS).

Enel Distribuzione started a program to ensure the homogeneous propagation of the automation to the entire MV distribution network.

The present software tool has been created to help the development of the automation program on all the Italian territory and to assist all the people involved in the project.
Presentation

- Introduction
- Network automation philosophy
- Software tool description
- Experience and main benefits
- Conclusions
Network automation philosophy

NAS is a system capable to operate the fault location, its isolation and the service restoration, automatically without the intervention of man.

The NAS philosophy (called FNC) works differently in dependence of the type of the fault that is detected by the fault detectors:

• a short circuit is isolated after several trips of the circuit breaker (the entire feeder suffers some supply interruptions);

• an earth fault is isolated without any tripping of the circuit breaker (only the healthy sections located downstream the faulty suffer a single supply interruption).
Presentation

- Introduction
- Network automation philosophy
- Software tool description
- Experience and main benefits
- Conclusions
Software tool description

The tool shows the entire network of an operative area, by giving for it and for each its part all the parameters necessary for the technical project.

The tool assist in the decision making, taking into account all the issues:

- the activities into the primary substations;
- the activities into the nodes along each MV feeder;
- the benefits and the costs;
- the condition of the earthing systems in the entire network under automation;
- the scheduling of the investments.
Software tool description

The tool is organized in the following application:

- Project overview;
- ADs placement;
- Primary substations activities;
- Conditions of the earthing systems;
- Investments scheduling.
Software tool description

Project overview (1 of 3)

This page illustrates the global state of the project for all the network, that is presented in hierarchical organization.

All the data are available for all the levels of organization.
Software tool description

Project overview (2 of 3)

The data are the following:

- structural data;
- data about the customers (type, number, location);
- foreseen data about quality of service;
- historical data about quality of service;
- project progress indexes;
- cost/benefits indexes.
Software tool description

Project overview (3 of 3)

The contribution of each part of the network to the quality of supply of the CO₂, is measured through a special index.

The value of another special index indicates the parts of the network that require more investments.

Since the project is made to the planner (that can change significantly the allocations suggest from the optimization algorithm) a cost/benefits index is available.

During the scheduling of the investments, these index permit to give priority to more critical areas.
Software tool description

ADs placement (1 of 2)

The application assists the planner, in order to explore a sufficient number of alternatives and to avoid non-optimal choices.
Software tool description

ADs placement (2 of 2)

The automation devices are located along the feeder through an optimization algorithm [C. Noce, 2009, "Optimal placement of automation devices in Enel distribution network", CIRED 2009].

The planner can modify the allocations; during this process he receives the results of the change in terms of pre-defined performances value.

The benefits are calculated starting from theoretical and the historical data.

The costs are calculated combining specific unitary costs; each complex activity is made by elementary activities, each elementary activity has a cost.
Software tool description

Primary substations activities

The application illustrates the state of the activities in all primary substations of the considered network, moreover it permits to plan the work needed to adjust the site not capable to perform the NAS.
Software tool description

Conditions of the earthing systems

The application illustrates the state of the earthing systems in all the nodes and it permits to plan the work needed to adjust the sites not capable to perform the NAS.
Software tool description

Investments scheduling

The application illustrates the global plan of the investments needed to perform the work fixed in the other applications. After the closing of the project in the CO, all the activities, benefits and costs are well known; this software permit to plan the investments in the years.
Presentation

- Introduction
- Network automation philosophy
- Software tool description
- Experience and main benefits
- Conclusions
Experience and main benefits (1 of 2)

- **completeness**, all the necessary data and all the activities has been managed in a single tool;

- **alignment with the field**, all the network components and its connections are presents in the db, besides the utilization of this software package has been the initial step in the updating and completion of the capacities of the existing equipment;

- **flexibility**, the technical level of the planning engineers has been valorised, because this software is theirs assistant and not a substitute;

- **support to optimal choice**, the value of the indexes, the cost/benefits analysis and the optimization algorithms are a complete and various set in order to avoid the not optimal choice;
Experience and main benefits (2 of 2)

• **information interchange and team work**, each project has been preview (or modified) for more people in different site and the same time, that has permitted an efficient sharing of experience and a profitable round table;

• in case of **great network reconfigurations** (creation of new primary substation, creation of new feeders etc.), the software receives automatically the new network configuration and generates an alarm in all the involved projects. In case of the planner decides that the projects are good (also in the new network schema), all the index are recalculated; the planner can change or confirm previous activities, moreover if some work have already been done, the relative cost are charged.
Presentation

- Introduction
- Network automation philosophy
- Software tool description
- Experience and main benefits
- Conclusions
Conclusions

An integrated system of applications, **using in Enel Distribuzione to planning the Network automation in the MV distribution network**, has been presented.

A rich set of functional possibilities was described, these are contained in **five main software applications**.

Through the results **obtained in one year of utilization**, the positive experiences and benefits of utilization of this integrated system were shown.

**One year has been enough to complete the projects for the entire distribution networks; in all the case, the planning activities have been faster than similar ones made in the past.**
Software tool for planning the automation of MV feeders in Enel distribution network

Gino Di Minni
ENEL ICT
Italy

Christian Noce
ENEL Distribuzione
Italy

Angelo Ovarelli
ENEL Distribuzione
Italy