Distribution grid planning

Solutions in the context of the energy transition and regulation

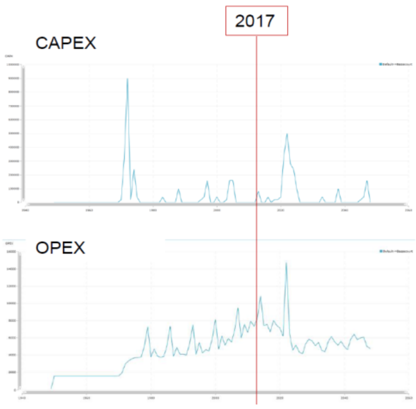

Figure 1: Asset simulation for cables in the medium voltage grid

At a glance

Siemens Power Technologies International (Siemens PTI) has decades of experience in planning public distribution grids. From the low voltage level up to the 110 kV distribution grid level, we cover the entire spectrum of challenges. From conceptual questions, such as the development of optimum grid structures and planning criteria, to strategic considerations, such as target grid planning, and operational tasks, such as protection setting calculations and the optimum placement of smart grid technologies on the grid.

The challenge

In the context of regulations and the energy transition, operators of public distribution grids face a wide range of challenges, some of which mutually influence each other.

Initially, the optimum annual budgets for grid investments are determined within the regulatory framework. Over the years, these investments must then be implemented on the grid at the correct location and at the correct point in time, such that the grid develops into the most efficient and reliable target grid. Furthermore, the most robust possible planning criteria must be defined so that the target grid concept can be retained even if load and generation prognoses are off the mark - e.g. due to increasing penetration of electric vehicles or distributed power generation systems. If necessary, these new boundary conditions must be met with the new technologies of smart grid generation. This in turn requires a reasonable implementation process for these technologies, so that they can also be implemented from the correct perspective, at the right place and at the right time. Finally, the implemented protection concept must also be as robust as possible, so that the settings do not have to be continually adjusted for changing grid and feed-in conditions.

Our solutions

Asset simulation

The long-term annual budgets for grid investments and operating costs (CAPEX, OPEX) are determined from the equipment available and the age structure of the current grid.

A forecast of the aging behavior of the grid and the future supply reliability it provides can also be derived by varying the budget limitations for the different groups of resources.

Target grid planning

A target grid that ensures high efficiency with regard to grid costs and reliability provided over the long-term is developed in close cooperation with grid operators. Target grid planning is based on previously agreed upon generally applicable planning criteria. Compliance with these planning criteria is checked through load flow, short-circuit and reliability calculations. Planning efficiency is verified by comparison of the costs and the provided supply reliability of the actual and target grids. All of the necessary measures for implementation of the target grid are documented in detail.

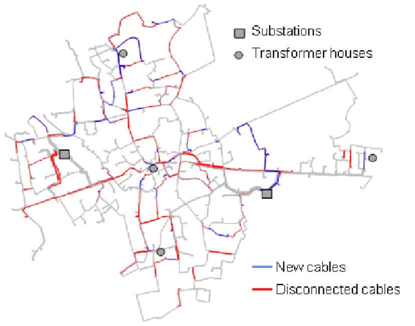

Figure2: Target grid planning in an MV grid with the necessary measures for implementation

Reinvestment and implementation planning

Under consideration of the annual budget and knowledge of the target grid to be achieved, the sequence of reinvestments and of the measures for implementation of the target grid are derived from the condition and significance of the resources that are still present or are no longer present in the target grid.

Figure 3: Condition/significance diagram for cables in the MV grid

Grid protection

The current protection concept is checked for selectivity and practicability (general applicability). Improvements are suggested based on this, and individual protection settings are determined for distance and definite time overcurrent protection.

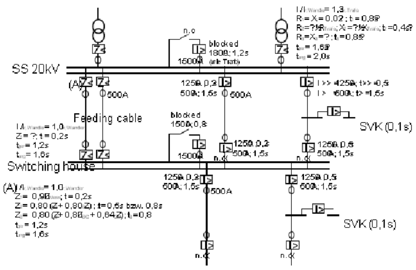

Figure 4: Grid protection concept for a MV grid

Smart planning

If the assumed boundary conditions for target grid planning change – for example due to an increasing penetration of the grid by electric vehicles or distributed power generation systems – impending violations of restrictions must be counteracted at an early stage through targeted implementation of innovative resources from the smart grid generation in the existing grid structure. This could mean measures such as an implementation process for controllable local grid transformers (rONT) and/or medium voltage in-phase regulators or an implementation process for intelligent transformer substations (iONS) for remote signaling in the event of a fault and remote control of disconnector switches.

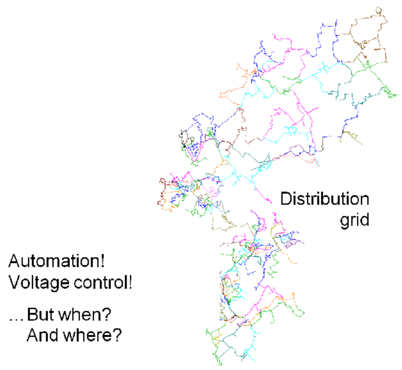

Figure 5: Smart Planning: Intelligent placement of resources from the smart grid generation

Low-voltage grid investigations

Because low-voltage grids are directly affected by changes in load behavior, this – long-neglected – grid level will merit increasing attention in the future.

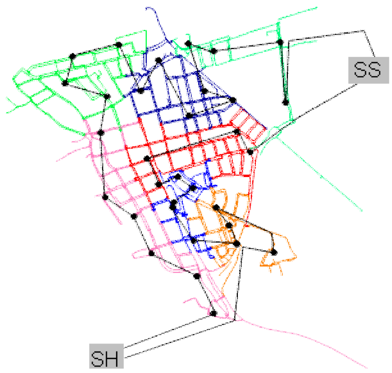

Figure 6: Low-voltage networked grids with single-phase input

Typical tasks on the low-voltage side are as follows:

- Determination of the optimum low-voltage grid form
- Determination of generally applicable planning criteria
- Resolution of low-voltage networked grids
- Evaluation of effects on the grid from distributed power generation systems
- Investigations regarding compliance with the shutdown condition
- Dimensioning of charging infrastructures for electric vehicles
- "What-if" investigations: Quantification of the critical growth of PV systems, electric vehicles, heat pumps etc

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