Abstract Format

Technologies reshaping the electricity supply industry
2017 IERE-TNB Putrajaya Workshop
November 20-23, 2017

Smart Sizing: A tool for long term planning of smart distribution networks

Parvathy Chittur Ramaswamy
François Depierreux
Stijn Cole
Energy Transition, Tractebel,
Brussels, Belgium

Keywords: *distribution networks, flexibility, investment, long term, planning tool*

Abstract

Worldwide, distribution utilities carry out long-term planning activities for their systems and have been using domain knowledge and experience in arriving at planning decisions. In the last years, smart grids developments have opened new possibilities both in infrastructure and operational planning of distribution networks. To exploit them, the first challenge lies in the identification of the most relevant smart grid technologies, based on their cost of deployment and the benefits that can be expected from their operation. As this must be performed at the planning level, the usual methodologies for long-term distribution planning have to be adapted.

This paper illustrates the impact of smart grids in the development of the distribution networks through a case study with different scenarios. Through this study case, this paper also presents the methodology followed in the Smart Sizing tool, a planning tool that takes into account smart technologies such as distributed generation, load flexibility, and ICT.

The scenarios consider different levels of available flexibility (no flexibility, load shifting, load shedding) , consequently leading to different least cost development plan proposals, with different total costs that is, investment costs and operational costs. The comparison then shows the cost reductions attained with the different levels of flexibility introduced in the system and permits different evaluations:

- Evaluation of the effect of flexibility on the operation and infrastructure cost
- Evaluation of the type of required flexibility and its profile in a network
- Evaluation of the critical cost of flexibility

The mathematical formulation of the optimisation problem is explained and different features and capabilities of the Smart Sizing tool are also illustrated.

At the heart of Smart Sizing lies an optimization routine that minimizes the total cost of the network, i.e. the sum of CAPEX (infrastructure cost) and OPEX (operation cost) over the

study horizon. The decision variables of the optimization problem are related to the investment in electrical equipment, such as the number of substations, the number of transformers per substation, the cable section etc. Examples of constraints include restrictions on voltage drop, loading of equipment, etc.

In the end, the role of the Smart Sizing tool in the long-term planning process is to find an ideal target network, and provide details on the costs and benefits of the different options considered, which can then be used as guiding principle in the network expansion decisions.

Reference

1. V. F. Martins and C. L. T. Borges, "Active Distribution Network Integrated Planning Incorporating Distributed Generation and Load Response Uncertainties," IEEE Transactions on Power Systems, vol. 26, no. 4, Nov. 2011.
2. P. Chittur Ramaswamy, C. Delhaute and S. Cole, "Long-term planning of electricity distribution systems integrating flexibility options," International Symposium on Smart Electric Distribution Systems and Technologies (EDST) 2015, Vienna, 2015, pp. 109-113