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Integration of distributed energy resources (DER)

Technical feasibility, energy management and active network integration

At a glance

Successful integration of distributed and renewable generation (DG) into distribution networks heavily relies on effective planning and operation strategies.

Siemens Power Technologies International (Siemens PTI) can provide you with a wide spectrum of consulting services covering both decentralized energy management and active network analysis for optimized interconnection and operation strategies.

We can enhance your business through:

- expert know-how and field experience to help develop the most cost-effective integration solutions for DG
- state-of-the-art software tools (e.g. PSS®SINCAL) and advanced case-specific software tools to explore the full potential of DG
- interconnection guidance, network impact analysis and solutions for distributed generation

The challenge

Due to both environmental and supply security requirements, there are increasing shares of distributed energy resources (DER) on the grid, comprised of distributed and renewable generators, controllable loads and possibly co-generation or storage units. However, integration of DG into a distribution grid poses a considerable challenge to existing planning and operation methods and software tools.

Figure 1: Distributed energy resources

In addition, large shares of DG may change the conventional top-down structure of the electricity industry. A whole new genre of technical and economic issues will arise from this change and unique solutions will be required.

Utilities have noted this trend for several years. Previously, small distributed generators were connected to the distribution grid without dedicated system studies. Today, distributed generators also have to provide services that were typically in the responsibility of large power plants connected to the transmission system only. Thus, numerous technical details and conditions need to be considered when distributed generators are connected to distribution networks. Consequently, a significant set of studies is required.

Our solution

With Siemens PTI's strengths in developing individual solutions and vast experience, we offer high-quality engineering solutions for both network-based and utility-based problems of distributed and renewable generation – or even both aspects combined.

Our areas of expertise cover:

- steady-state and dynamic simulation of DER integration
- loading of network and equipment, transmission constraints
- power quality fault ride through behavior, short circuit power protection of units and network
- reliability assessment

Network analysis

This approach enables the network operator to identify the right connection strategy before the actual installation of DER. The optimum solution has to consider several aspects, such as the

optimum connection point to the grid, dimensioning of the switchgear considering technical and economical aspects, losses, power quality and reliability of supply.

Power quality impacts
The impact of connecting DER to the grid is investigated, considering voltage unbalances, flicker and harmonics with respect to the valid national and international standards and regulations. With the import options of PSS®SINCAL the network model can be created on the basis of geographical information system (GIS) data in a time saving and efficient manner.

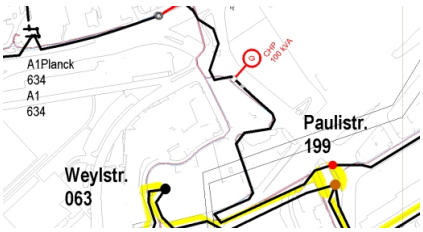

Figure 2: Calculation based on geographical network model

The necessary calculation steps will be carried out with PSS®SINCAL. They are embedded in a calculation framework, which allows the automated calculation for steady state and power flow simulation that consider loading and generating daily, monthly or yearly profile. Furthermore, the results are compiled in a detailed report. This approach enables us to carry out a complete network study in a very efficient way.

Optimum connection points
If the shortest connection to the grid is not technically valid, then another connection point will be determined with respect to technical and economical aspects. The routing will be done on the real trench course, which enables us to take realistic investment costs into account.

De-coupling concepts
Due to their significant amount to total power production, DER have to participate in ancillary grid services. Therefore the de-coupling relay should not trip instantaneously in case of external faults. In fact, the de-coupling switch should only trip if the stability of the generator cannot be guaranteed anymore. Therefore the calculation of the stability limit of the generator is required to determine proper setting values for the de-coupling equipment.

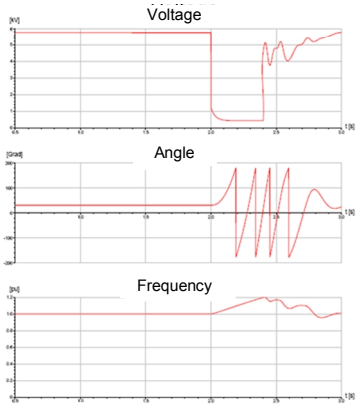

Figure 3: Determination of the de-coupling criteria with dynamic simulations

Protection concepts for DER
DER have to be protected against impacts of external, as well as internal faults. Therefore, protection concepts depending on the power and the importance of the generation unit have to be designed. Furthermore, the necessary protection calculations are carried out with protection settings for all related protection devices.

Power quality measurements
If DER are connected to the power grid via electronic converters, then the generation units will contribute to the harmonic load of the grid. If the harmonic content of the bus voltages exceeds the limits, the necessary improvement measures are taken. To reach this goal Siemens PTI can offer different services, for example filter design.

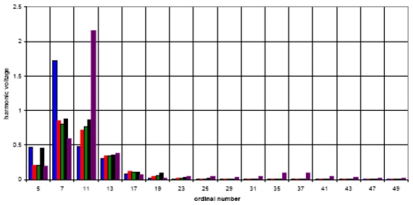

Figure 4: Determination of the harmonics for a network with dispersed generation

How you can benefit

Remote access to the client's network database, when agreed upon, enables us to update the network model in a very efficient way. The calculations of the relevant planning variants take place within a dedicated planning framework. This allows us to carry out a complete DER connection study in a very efficient way for calculation of the results and the preparation of the relevant reports.

We support our clients in:

- evaluating the techno-economically optimized DER placement and integration (sizing and optimal placement)
- ensuring reliable power supply with distribution system analyses
- verifying compliance with network codes and providing network connection studies
- leveraging (new) business opportunities, roles and applications with business case studies

Published by
Siemens AG 2018

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