ProFuDiS

Protection for Future Distribution Systems

The integration capacity of distributed energy resources (DER) in low (LV) and medium voltage (MV) distribution grids could be restricted further due to present protection systems. This is due to the influence of DER onto the short circuit currents.

Investigations show that today's penetration rates with DER do not yet lead to systematic protection failures. Realistic installation rates as well as the increasing complexity of future grid structures will lead to challenges for the protection systems. Within the research project ProFuDiS (Protection for Future Distribution Systems) these challenges are identified and specific solutions are derived.

The research project ProFuDiS (www.profudis.de) is funded by the German Federal Ministry for Economic Affairs and Energy and deals with the question in how far today's grid protection concepts are still applicable in future distribution grids with a large share of DER or which changes need to be made. The consortium of universities, research facilities, grid utilities and industry partners identifies possibilities for reliable, safe and cost-efficient protection concepts for future distribution grids (Fig. 1). The concepts are evaluated and the basics for their realization are developed. It is thereby mandatory to ensure a proper protection, which is cost efficient and allows the integration of a large amount of DER. Recommendations for suitable solutions for a safe operation of the overall system need to be derived. For the first time proper models and methods are developed, verified against laboratory measurements and applied in parameter variation studies. For the model building and verification, extensive laboratory tests in the Testing Center of the IFHT as well as in hardware-in-the-loop protection labs are conducted.

Both, the simulative and the laboratory tests with actual grid assets in the testing facility of the IHFT show that a large share of DER in parts of LV grids can lead to a significant extension of the tripping times of conventional NH-fuses, up to a failure (Blinding). With the help of products, already available at the market today, these problems can successfully be faced, but in a highly inefficient way concerning the costs. First approaches for technically suitable and cost-efficient solutions are derived within the project, and successfully tested in the IFHT Testing Center using realistic grid topologies. Further investigation is needed to bring them to a level of development suitable for the commercial market.

Common digital protection devices can prevent Blinding through DER today already when parameterized properly or used in an unconventional way. In long, radial lines with high infeed with inverter interfaced DER an unconventional application of overcurrent relays with different current thresholds for each direction can, for example, increase the possible maximum infeed capacity. Today's directional overcurrent relays are applicable in this case, when the DER are supplying a reactive fault current for a dynamic grid support, as long as a proper firmware and parameterization is used. These are identified within the project in cooperation with the participating protection relay manufacturers.

In the future, the calculation of short circuit currents in cause of the protection planning process will become increasingly important for both, MV and LV grids. Proper calculation methods need to be used, which, amongst other, allow the correct representation of the current source behavior of inverter coupled DER. Furthermore the behavior of DER needs to

be regarded using suitable modelling and parameter variation calculations. The basis is, due to this research project, available now.

Especially the highly diverse behavior of inverter interfaced DER, e.g. according to their active current infeed, asymmetric behavior, maximum settling times in case of dynamic grid support, should be reasonably restricted and standardized in future norms and guidelines. This would allow a reliable and efficient short circuit calculation for the protection planning.

Project information

Partners

- RWTH Aachen
- Innogy SE
- SMA Solar Technology AG
- FGH e.V.
- htw saar

Facts

- Acronym: ProFuDis
- Duration: Dec. 2012 – Dec. 2016

Supported by:

Federal Ministry for Economic Affairs and Energy

on the basis of a decision by the German Bundestag