Master's thesis

Analysis and evaluation of aggregation concepts for decentralized energy generation to enable ancillary services provision at distribution grid level

Worldwide, the share of renewable energy sources in the generation portfolio is increasing. The decentralized plants are connected to the distribution grid and pose new challenges in coordination for grid operation at the low and medium-voltage level. In order to meet these challenges, different aggregation concepts are proposed in research and practice. Well-known examples are Virtual Power Plants, Active Distribution Networks and Microgrids. Such aggregators offer joint usage of several generation plants and can collectively enable participation in system services, such as primary or secondary control.

This work aims to investigate the applicability of various aggregation concepts in present and future grid operations. It should be shown whether and to what extent grid operators can procure selected system services from such aggregators. First, it has to be determined which ancillary services can be provided in principal. Afterwards an exemplary activation of the selected ancillary services is used to analyze which aggregator types are particularly suitable for this. It is important to differentiate between the named aggregators in this working step. Subsequently, a simulation should show how the selected system services can be provided in a grid-supporting manner. In doing so, not only the generation plants have to be considered, but also the loading of the grid equipment. Stability limits in distribution grid operation must also be taken into account in order to enable the evaluation of concepts from a grid operator's point of view. One conceivable approach is to determine the system service demand at the connection between the grid levels and later simulate several distribution grids.

The following structure of the work is proposed:

- Literature research on network models (medium voltage level) and different aggregation concepts (Active Distribution Networks, Virtual Power Plants, Microgrids, etc.)
- Analysis of selected aggregation concepts to provide ancillary services and identification of use cases
- Familiarization with a suitable simulation environment, e.g. DIgSILENT PowerFactory
- Simulation of relevant case studies for ancillary services provision and comparison of different aggregation concepts

Start of work: TBA

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