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Requirements for the Simulation of Active Networks

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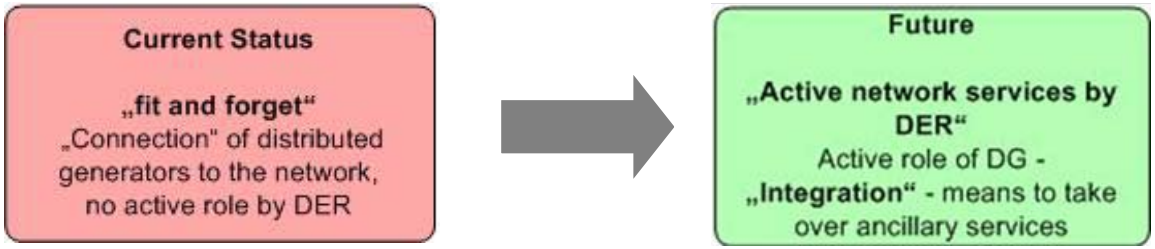
2. Internationales Symposium für Verteilte Stromerzeugung und Intelligente Netze
18.10.2007
TECHbase Vienna

Content

- Background
- What must/should be simulated?
- Which data and tools are necessary?
- Summary

Background

- increasing share of distributed generation in distribution networks
- with current network planning and network operation approaches only a limited share of DG is possible



- consider the active approach in network planning and operation
- new challenges for assessment and simulation tools
  - validate the influence on the network
  - validate the benefits on network operation

What must/should be simulated?

- steady state analysis for normal operating conditions (load flow analysis)
- dynamic simulations for protection coordination
- electromagnetic fast transients simulation to identify the influence of:
  - DG units on the networks
  - the network on DG units
- reliability studies
- consider spatial and structural boundary conditions (GIS)
- simulate the overall benefits of DER-Integration and the SmartGrid approach

What is necessary?

- network data
- models for generators and loads (both for steady state and dynamic analyses)
- network control concepts
- spatial and structural data
- integration of all these data in the simulation surrounding
- capable approaches to validate the influence of the network on DG units
- capable approaches to validate the influence of the DG unit on the network (benefits)

Network Data

- for the voltage networks in general available (in several datbases)
  - higher level network
  - transformers
  - lines
  - nodes
  - location of the assets
  - switching status of the network (normal condition and switch over)
  - available secondary equipment

  for scientific surveys often the compatibility of different software tools is a barrier

- in Austria for low voltage networks the network data are available only in a limited amount

Models for Generators/Loads (1)

- for steady state analyses
  - unit parameters (nominal voltage, -power, cosφ)
  - generation and load profiles
  - models to generate the profiles (probabilistic models)

- for dynamic analysis
  - lack of universally accepted models for generators
    - > PV-Inverter
    - > Fuel Cells
    - > Micro CHP, Micro Turbines
    - > different wind power converter (IG, DFIG, SG – Inverter)
  - internally control strategies
    - > behaviour in case of network disturbances and faults

Models for Generators/Loads (2)

- **ancillary services provided by generators and loads**

  both in dynamic and steady state analysis

  - > **contribution to voltage control (active and reactive power management)**
  - > **reactive power management**
  - > **harmonic filtering**
  - > **loss reduction**

  is it possible to have access to the unit control (control signals)?

Spatial and Structural Data

- to consider:
  - availability of electrical infrastructure
  - geographical aspects (topography, land use…)
  - availability of primary energy sources
  - Infrastructure (i.e. roads)
  - local demand structure (i.e. electricity- and heat demand)
- support for site selection
- based on the data assessment of the units benefits at a certain site
- estimation future potential

New Control Concepts

- for active network control with involvement of all players in the network
  - network operator
  - consumer loads
  - generators
  - storage

  new concepts for network operation are necessary
- voltage control concepts
- models for ancillary services
- easy development and integration of control concept in network simulation should be possible

Assessment of Active Networks

- hosting capacity of the networks
- power quality
- utilization of the available voltage band
- reactive power management
- Utilization degree of the network assets
- network losses
- contribution of DER to network operation

from this follows the determination of the effectiveness of different concepts for Smart Grids

Summary

- new challenges for models and simulation tools due to Smart Grids
- more data from the network are required
- models and control strategies need to be developed
- new approaches to validate benefits of SmartGrids are necessary
- for the user it should be as easy as possible to integrate this functionalities into simulation tools