Maximal Hosting Capacity (ICA)

PSS®SINCAL

At a glance

The global trend for cleaner power, supported by new technologies (such as solar and wind farms, as well as affordable rooftop photovoltaic panels), has changed the distribution system landscape. Power generation has become increasingly volatile and power flow is bi-directional. Networks are changing from passive to active, and consumers to "prosumers". The challenges are similar to those of transmission networks but with a higher impact: these grid are weaker, unbalanced and do not have the control mechanisms a transmission grid offers.

In order to ensure the stability of these systems, power system planners need to know how much renewable energy infeed their distribution system can host in terms of power quality and reliability without needing to enhance the existing network.

The challenge

Grid connection highly depends on the point of common coupling. Therefore an assessment needs to be performed for every single installation to determine if the network will still be without limitations. The ever-increasing volume of distributed energy resources (DER) interconnection requests creates a need for new and innovative engineering tools that allow speeding up these requests by automatic processing. These should even allow customers to evaluate if DER can be connected without compromising the network's reliability and power quality.

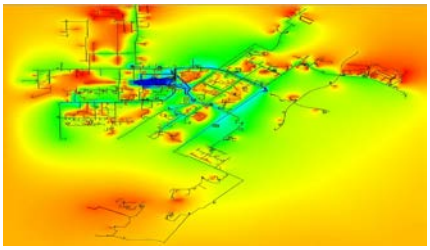

Figure 1: Network with interconnection power levels: blue= high; red= low

Our solution

The new PSS®SINCAL ICA (Integrated Capacity Analysis) module automatically determines the maximal generation or load capacity that can be installed independently at each point of the distribution system without violating user-given constraints. This enables a systematic and cost effective analysis

This module combines different calculation engines like power flow and short circuit with network adoptions within one single workflow. This systematic and cost-effective approach allows a power system planner to get results for the complete system.

This approach takes into consideration the existing penetration of energy generation and load estimation over a reasonable time frame to put the results on a consolidated database, also for the future network. With just a mouse click the DER under consideration can be plugged into the network for further detailed evaluation, according to grid connection standards like BDWE or NER.

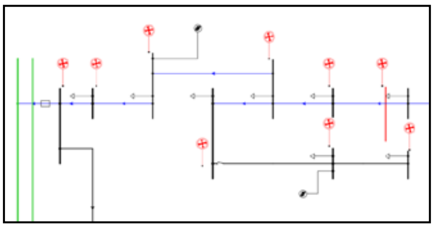

Figure 2: Simulation concept

A correct network setup is very important; the set-up must include a detailed modeling of separate loads and generators with historic or forecasted behavior. Concerning network layout, for instance, this data can be derived from a GIS system, or from MDM systems for prosumer behavior. Besides full profile simulations (i.e over one year with a one-hour time step), it is also possible to customize this evaluation time. This is done in user-defined profiles with a minimal and maximal number of days, or using special operation points, such as minimum loading while maximum generation is effective, or maximum loading while minimum generation, etc. For a quick scan it is possible to only use the actual network state or complete a simple load scaling with factors.

The user can also customize and define the criteria the software needs to check. This is of equal importance to the selection of key network data.

A wizard guides the user through the complete process and offers further investigation methods in an interactive dialog. It allows a user to define the specific behavior of the DER generators (e.g. disconnection because of too high or low voltage or correct contribution to the short circuit) and to set the different parameters for the assessment criteria.

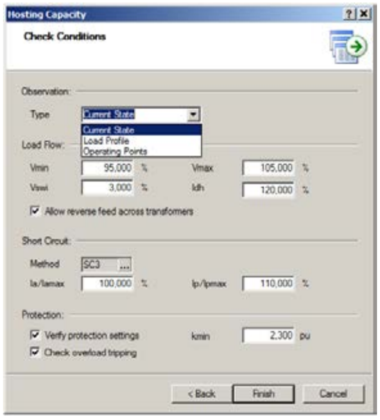

Figure 3: Sample mask of the ICA wizard

The analysis uses the fully iterative method to evaluate the following criteria:

- Thermal loading of all network equipment in the full system, based on user-defined limit sets by device level or network area for all investigated time steps.
- Voltage Limits –Power Quality for each node in the system and each evaluated time step, the steady-state voltages are checked against the user-defined min. and max. voltage limits, e.g. 95-105%.
- Voltage fluctuation caused by sudden fluctuations of the linked DER / load are evaluated at each point of the network against a user-defined limit of, e.g., 3%.
- Short-circuit persistence of network equipment is checked based on the device or network settings like peak and breaking short-circuit currents all over the network and in all time steps. Breakers are taken into consideration as well.
- Reverse flow through limiting transformers can be allowed or has to be blocked to ensure flexibility in network operation. If the reverse flow should be blocked the system calculates the power to each node that can be linked without creating a flow through the transformer.
- Protection assessment is performed for the linked DER protection zone by short-circuit sweeps and different fault scenarios. The zone factor for the limiting protection devices of the DER is not allowed to fall below a user-defined value (e.g. 1.8). Also tripping due to the normal power flow can be checked.

The PSS®SINCAL report view provides a quick overview for all nodes in a tabular form with interactive links into the network map and various sorting, filtering and evaluation features. The calculated generator can directly be added to the network with one click.

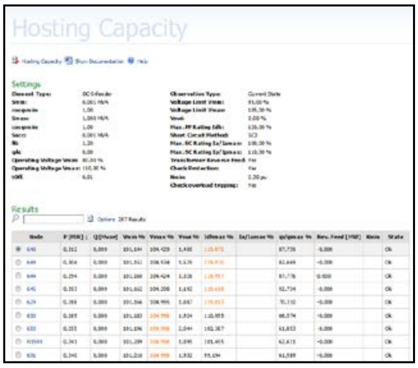

Figure 4: Interactive report view

Results can be presented in an online diagram in several forms – e.g. by color coding the network contour or only the nodes, or by an overlay on top of an interactive internet map directly in the PSS®SINCAL GUI.

Figure 5: Maximum power to be linked to each node without violating any limit with additional detailed evaluation

This diagram illustrates the different integration capacity levels in the system at all locations. E.g. it is clearly visible that at the end of a feeder the maximal hosting capacity is reduced, either due to steady-state voltage, thermal limits or voltage fluctuation.

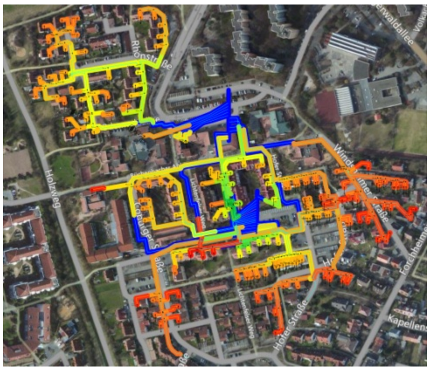

Figure 6: ICA within PSS®SINCAL on an interactive internet map (e.g. Bing Maps ©)

For proper documentation, a Microsoft® Word® report can also be generated and customized by the user. It shows the maximum hosting capacity at each node for the evaluated network together with the individual constrains and the color-coded limited value and critical time stamp.

Figure 7: ICA document report

The new PSS®SINCAL ICA module enables the user to quickly and cost-effectively evaluate the best location of a planned DER. In addition, the module helps to determine the generator or load size which can be linked to the system without the need for network enhancement. Thus it also supports the calculation of a network benefit by deferral of an already planned network investment.

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