



PLANT DESIGN AND GRID CODE COMPLIANCE FOR DEVELOPERS AND EPCS

System integration of renewable energy

At a glance

The demand for generation from renewable energy sources (RES) is growing faster than in previous years, not only in North America and Europe, but all over the world. Developers are pushing the boundaries of technology, producing larger wind turbines, more efficient photovoltaic modules, and high-capacity battery energy storage units, while investors are eyeing a great deal of new RES projects, some of which are now already in GW magnitudes.

The effect of integrating such large amounts of variable and partially predictable RES makes electrical power systems more vulnerable and poses challenges for developers and grid operators.

While developers seek reliable RES power plant design that can guarantee their return on investment, grid operators demand very strict technical guidelines to ensure safe operation.

Siemens Power Technologies International (Siemens PTI) combines its renowned expertise and extensive experience in power system consulting to offer:

- Complete solutions for RES power plant design and system integration
- Ensured, reliable and cost-efficient performance of RES power plants

Siemens PTI is the ideal partner during all phases of development and operation of RES power plants.

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The challenge

From the design all the way to implementation of RES power plants, several technical and economic aspects need to be taken into consideration.

In the design phase, plant components need to be optimally dimensioned so that performance expectations are fulfilled while investment and operation costs are kept to a minimum.

Grid operators require RES power plants to perform according to specific technical guidelines included in a grid code. The performance of an RES power plant at the point of interconnection is directly related to the technical characteristics of the plant's grid components. Consequently, a suitable and validated model is required to study the performance of the plant.

Our solution

Siemens PTI offers consulting services for the design of RES power plants, as well as for integrating these plants into the power system. Our solution bridges the gap between design requirements for the internal electrical network of the RES power plant, and reliable performance and control of the plant amid full compliance with the grid code. Our vast experience in generation interconnection studies enables us to ensure optimal integration of these plants into the grid.

RES power plant design

The following studies are typically offered for the design of the internal electrical network of RES power plants and an analysis of the behavior of plants as a whole:

- Grid design (cables, transformers, compensation)
- Design of protection systems and definition of settings
- Reliability focused design and availability analysis
- Estimation of energy losses
- Wind turbine/photovoltaics/battery storage modeling and validation
- Grid code compliance investigations (reactive power capability, fault ride-through)
- Island operation and black start capabilities
- Power quality, including harmonics analysis (on-site measurements and design of mitigation measures) and voltage fluctuation investigation
- Insulation coordination, overvoltage protection
- Lightning protection system design
- Neutral grounding design and dimensioning

- Grounding design for personnel safety
- Dimensioning of auxiliary system and equipment
- Arc flash study
- Plant-level controller design and modeling

Moreover, Siemens PTI offers its expertise to support solving technical problems during project execution and/or plant operation.

Application example: Offshore wind power plant

Siemens PTI has performed design and integration studies for a considerable number of RES power plants, especially large offshore wind power projects, worldwide.

An essential requirement for any grid analysis is a suitable model. For a wind power plant (WPP), a model represents the technical characteristics of the internal power system of the plant all the way down to the point of interconnection and includes the individual wind turbine models. Siemens PTI's PSS® Product Suite offers a wide selection of standard turbine models. In addition, Siemens PTI develops customized turbine models and validates them for the most accurate and realistic performance.

Grid code demands that WPPs comply with a set of technical requirements at the point of interconnection. Specific investigations evaluate performance of the WPP from several technical perspectives and help devise optimization.

Dynamic stability studies assess the dynamic behavior of the WPP under system disturbances. Included in these analyses is the comparison of WPP performance with fault ride-through requirements of grid code.

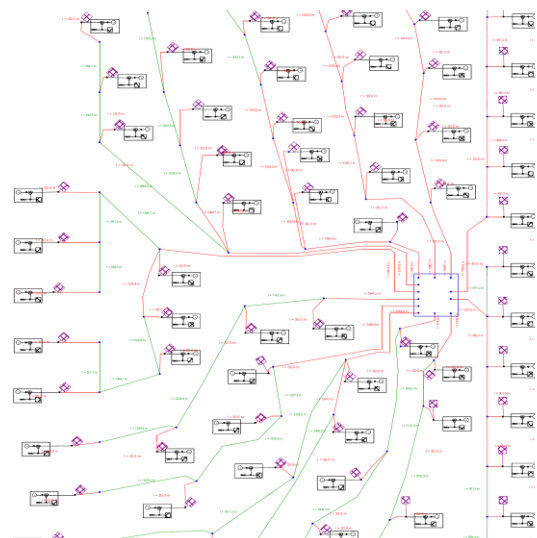


Figure 1: Network topology of an offshore WPP modeled in PSS®SINCAL

Harmonics analysis examines harmonic voltage levels produced by the WPP, combined with background harmonics at the point of interconnection, against grid code requirements and other standards (e.g., IEC 61000). Mitigation measures, such as design and implementation of harmonic filters, are devised in case the requirements are not met. The overall performance of the WPP with the mitigation measures is then verified.

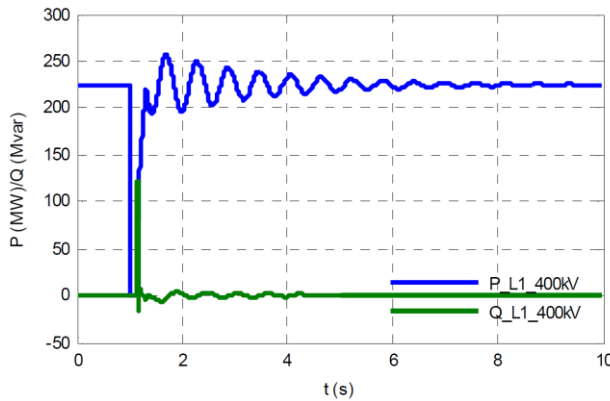


Figure 2: Real and reactive power curves during a fault-ride-through simulation

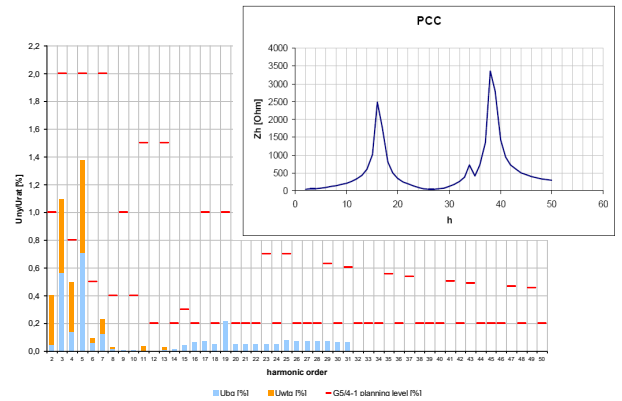


Figure 3: Harmonic spectrum at the point of common coupling

Contact

Are you interested in learning more about our services? We are happy to answer your questions. Please get in touch via our [web contact form](#).

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