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Reactive Power Provision by Distributed Generators: Field Experience and Recommendations

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Reference:
[1] Mende D. et al.: Reactive power control of PV plants to increase the grid hosting capacity, 28th PVSEC, Paris, 2013

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Objective

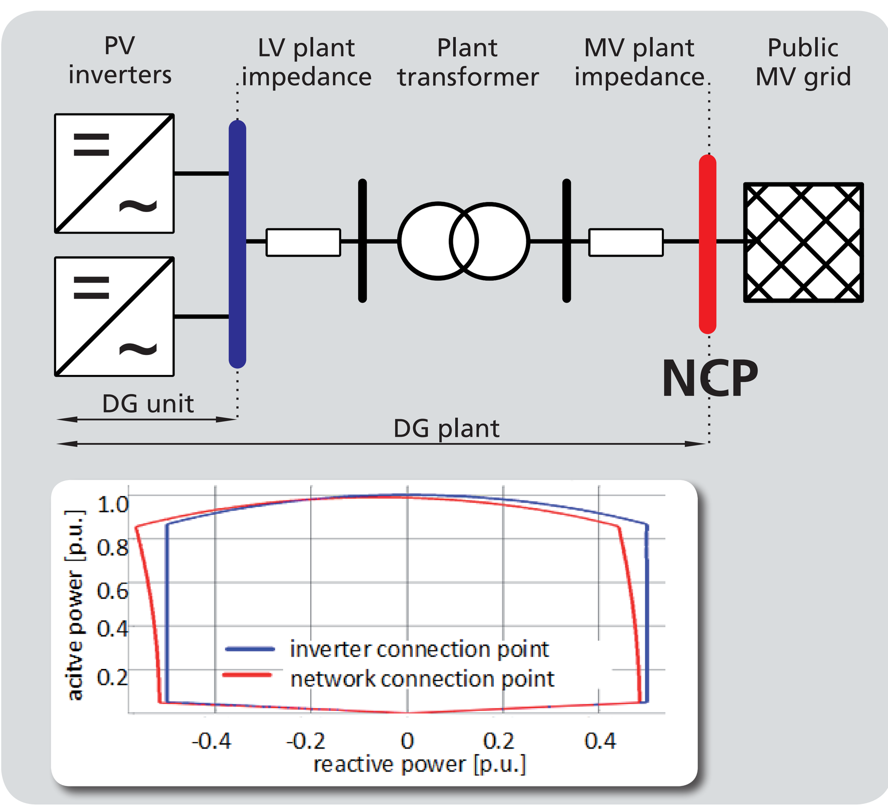
We present field experiences on reactive power control by distributed generators (DG) focussing on non-grid code compliant DG operation and their origins. The evaluation shows that the share of DG, which currently cannot be operated in full compliance with the grid codes and guidelines, is noticeable.

Error-sensitive tasks

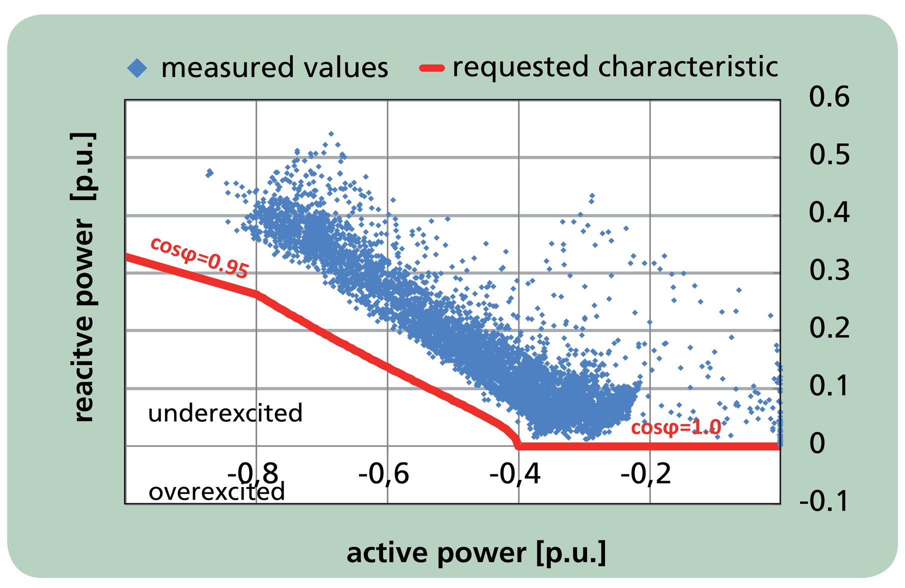
The issues and challenges related to a grid code compliant DG operation are multilateral and may concern the DG design, DG parameterization and DG operation process.

Example DG design process

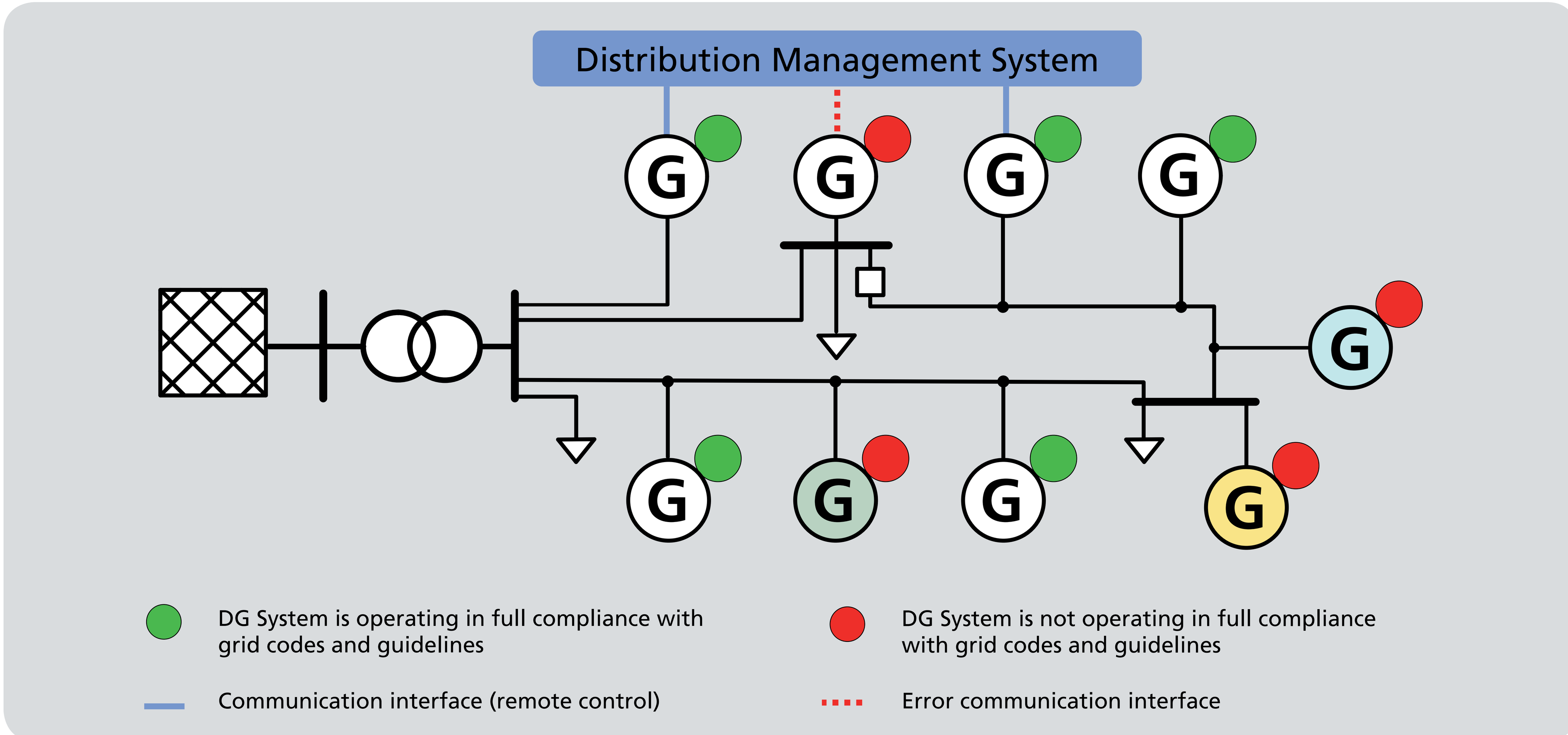
The impedances of the DG plant components are not sufficiently considered during the DG design process and the DG plant cannot show the requested behaviour at the network connection point (NCP). In Germany DG plant certificates are required for DG plants (S > 1 MVA) or DG plants with a long internal connection line. DG plant and unit certificates can minimize the risk of DG design errors.



Example of MV PV plant and the typical PQ operating range at the Inverter and the NCP (own diagram based on [1])

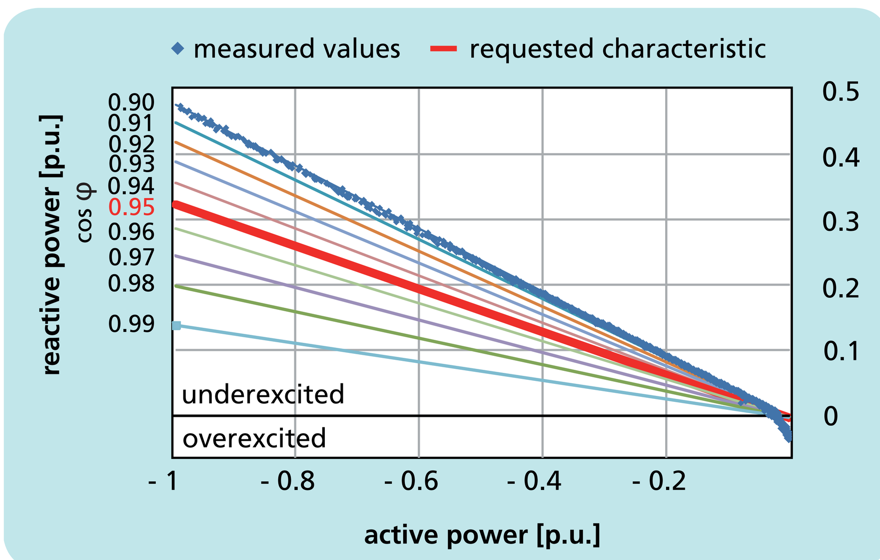


Measurement example DG: inaccurate performance of a cosφ (P)-characteristic

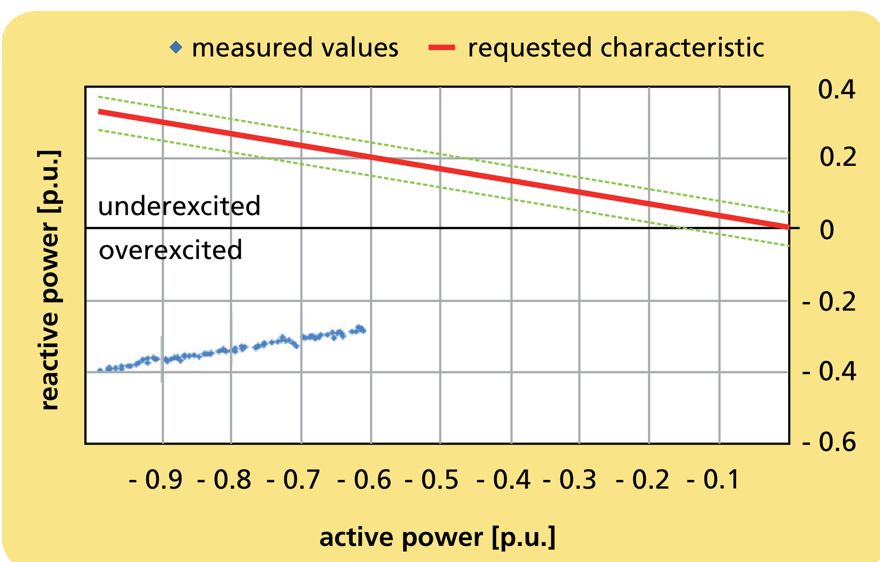


Example DG parameterization

The diversity of DG manufacturer dependent user interfaces is one major source for reactive power parameterization errors in the field. The requested parameter set values for reactive power control can differ strongly by manufacturer. Furthermore, the sign of reactive power provision is not standardized, which can lead to a direction error of reactive power provision, e.g. overexcited instead of underexcited operation.



Measurement example DG: non-grid code compliant local control due to a wrongly applied power factor



Measurement example DG: non-grid code compliant local control due to a direction error of reactive power provision

Example DG operation process

Failures of DG components, e.g. communication devices, can lead to a non-grid code compliant DG operation. For example, issues have been observed after firmware updates or after the exchange of DG components, e.g. PV inverters.

Example field test result

The frequency and relevance of the errors can differ per voltage level, DG type, DSO, region and date of initial start-up. Although the following statistics cannot be considered as representative, but they clearly indicate the relevance of this issue. In this field test one particular DSO requested active and reactive power target values from 186 DG (HV and MV level) via remote control.

The measurements revealed that:

- 84 DG showed requested behaviour
- 62 DG showed deficits
- 40 DG with communication error

Impact on grid operation

A non-grid code compliant DG reactive power control can affect the voltage control, the asset loading, and the protection system and can lead to a disconnection of DG, consumers or other grid assets. In an energy system, with increased system responsibility by DG, it is mandatory, that the DG operate predictable and according to the relevant guidelines and grid codes.

Conclusion

For an improved utilization of DG reactive power control the implementation of an industry-driven working group for defining binding parameter definitions and further commissioning standards is recommended.