Connection of Dispersed Generation to Distribution Grids Evaluation with NEPLAN®

Challenges	Integration of dispersed generation into distribution grids
Cutomer	Distribution system utilities
Advantages	Assessment based on technical rules / standards Reliable and user-friendly graphical interface
Solution	Module Connection Request for quick, simplified assessment, further specialized modules for an in-depth analysis

Dispersed generators, such as photovoltaic systems, are integrated into existing electrical networks. Thus, the utilities have the following problems to consider:

- Voltage rise
- Harmonics and interharmonics generated by converters
- Voltage fluctuations caused by power changes (sun, clouds, wind)
- Voltage unbalance due to single phase connection
- Increase of short circuit currents

Apartment house with photovoltaic system

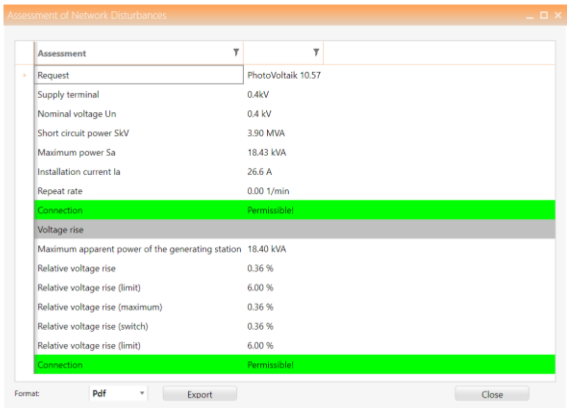
Connection Request

The assessment of a connection request can be made in case of simple network structures and in case of a few existing dispersed generators in accordance with the technical rules of the national association VEÖ (Austria), VSE (Switzerland), CSRES (Czech Republic) and VDN (Germany). This set of rules is implemented in the NEPLAN connection request module, which is available in all NEPLAN 10/360 installations. In NEPLAN 360 (cloud solution), this module is also available in a simplified, cost-effective form.

Loadflow and Short Circuit Calculations

If other dispersed generators are already in operation in a distribution feeder or low-voltage grid, the analysis often has to be more in-depth. The NEPLAN load flow module is used to check the voltages and loadings of the network components.

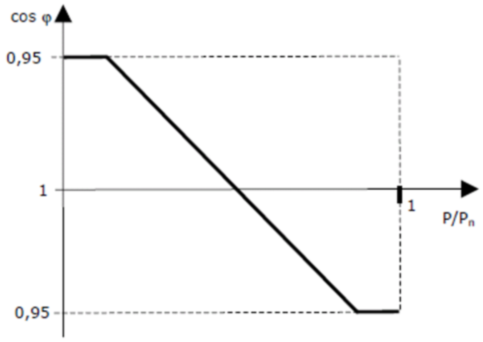
The increase in short-circuit currents caused by the additional dispersed generation is analyzed via the NEPLAN short-circuit module.



Assessment of a planned photovoltaic system - result of the module Connection Request

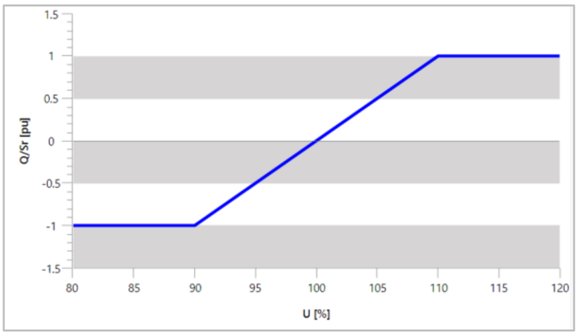
Voltage Control in Distribution Grids

If no voltage problems are to be expected, decentralized generators generally do not have to exchange reactive power with the grid, cos(φ) = 1.



Characteristic cos(φ) = f(P), BDEW guideline

However, if such problems occur, various measures must be checked by the network planner. Regulators, national associations or utilities create appropriate guidelines.



Characteristic curve Q = f (U) of a dispersed generator entered in NEPLAN

NEPLAN provides a number of models for this purpose:

- Controllable distribution transformers
- Constant power factor cos(φ) for dispersed generators
- Reactive power control cos(φ) = f(P)
- Reactive power control Q = f(U)
- Reactive power control cos(φ) = f(U)
- Active power limitation P = f(U)
- Voltage regulators in distribution feeders
- Current compounding for transformer control

The various control characteristics can be defined in NEPLAN using tables.

Control Characteristic

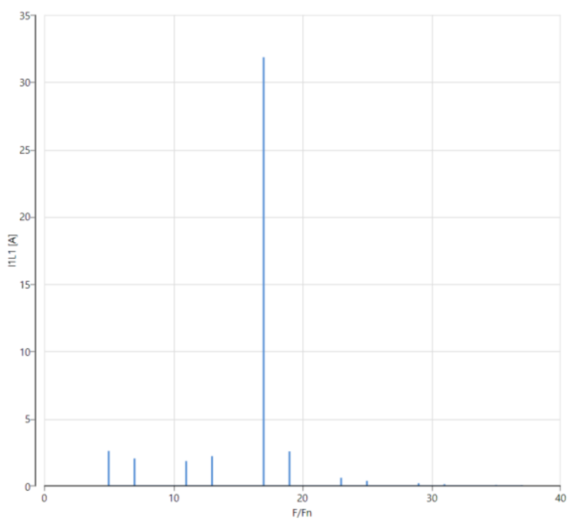
	U [%]	cosφ	Capacitive
+ Click to add a new item			
Delete	80	0.9	☑
Delete	90	0.9	☑
Delete	110	0.9	☐
Delete	120	0.9	☐

Table of a control characteristic cos(φ) = f(U)

Analysis of the Harmonics

Because of the use of converters, dispersed generators produce harmonics which may have negative effects on a network. In this context, the network itself plays an important role with its characteristic impedance.

The NEPLAN module Harmonic Analysis can be used to investigate the effects of different harmonic sources in detail. The harmonics can be summed up for the worst case, the best case and the real case.



Output of the harmonic analysis module, harmonics at a given node

Conclusion

Although the connection of a dispersed generator is permissible according to standards and guidelines, it can still be inadmissible for your own power grid. Therefore, more and more, network studies are required that include the analytical methods described above. NEPLAN provides comprehensive models and calculation methods for this purpose.