Study on the 50.2Hz Problem

Contents and Core Statements

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Current Situation I:

- Increasing proportion of renewable energies: about 20% of electricity generation (status I. + II. quarter of 2011)
- Photovoltaics: Share > 3.5%
- Rising number of installed PV systems means these systems are relevant to the system
- Regulation for improved system integration is also in progress for Europe
- Identification of the problem and Germany's role

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Current Situation II:

- A specific system-relevant task: Frequency stability
- New systems: Rules existing since April 2011, are already implemented (VDE-AR-N 4105)
- Old systems: Need for retrofitting was previously unclear → current joint study of network operators and the solar industry

Identification of the Problem

- Up until now, upon reaching an overfrequency of 50.2 Hz, generators connected to the low voltage distribution network had to disconnect from the network.
- If a larger-scale malfunction were to occur, a large portion of the power generated by PV systems could be lost in an instant.
  → System/network stability would then be severely jeopardized!
- A large number of PV systems is affected, these cannot be automatically converted.
- A conversion of PV systems may impact the operation of distribution networks.

Contents of the Study

- Examination of possible technical implementation options
- Evaluation of the solutions
- Recommendation of solutions
  - Technically appropriate
  - Ability to be implemented quickly
  - Economically justifiable
  - Safe and reliable operation of the distribution network
  - With the least possible expenditure for all involved

Implementation

Preference

In the majority of cases it will be necessary to go to the site because remote maintenance is often possible only with systems >> 100kW.

Solution 1:

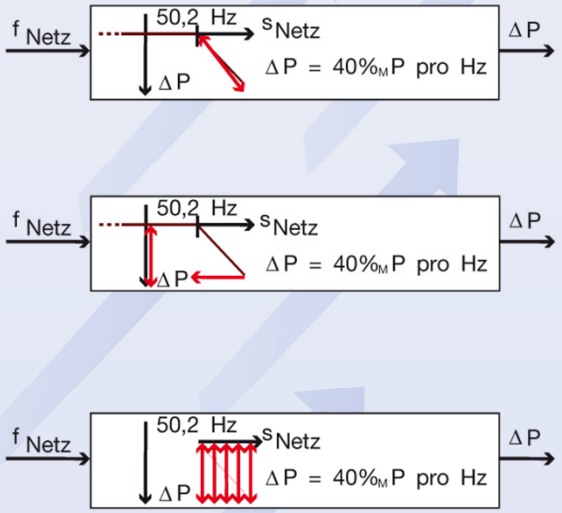
Update to FNN/VDE application guide 4105, characteristic curve, reconnection at 50.05 Hz after 60 seconds

Solution 2:

Reparameterization/update to BDEW-MS-RL (FNN temporary arrangement, option b), characteristic curve, reconnection at 50.05 Hz

Solution 3:

Reparameterization of the shutdown frequency=reconnection frequency (FNN temporary arrangement, option a), stochastic distribution according to inverter type, reconnection after 30 seconds



Need for Retrofitting

- Old systems that were put into operation after Sept. 1, 2005 and have an installed power > 10 kW_p .
- Small rooftop systems on single family homes are thus excluded from the retrofitting obligation.

Retrofitting

Retrofitting photovoltaic systems in the low voltage distribution network: as of Sep. 1, 2005 > 10 kW_p about 315, 000 units (about 9GW_{inst})

Solution 3: about 2/3

"Difference with respect to the remaining PV power to be converted"

Solution 1 + 2: about 1/3 (4 GW)

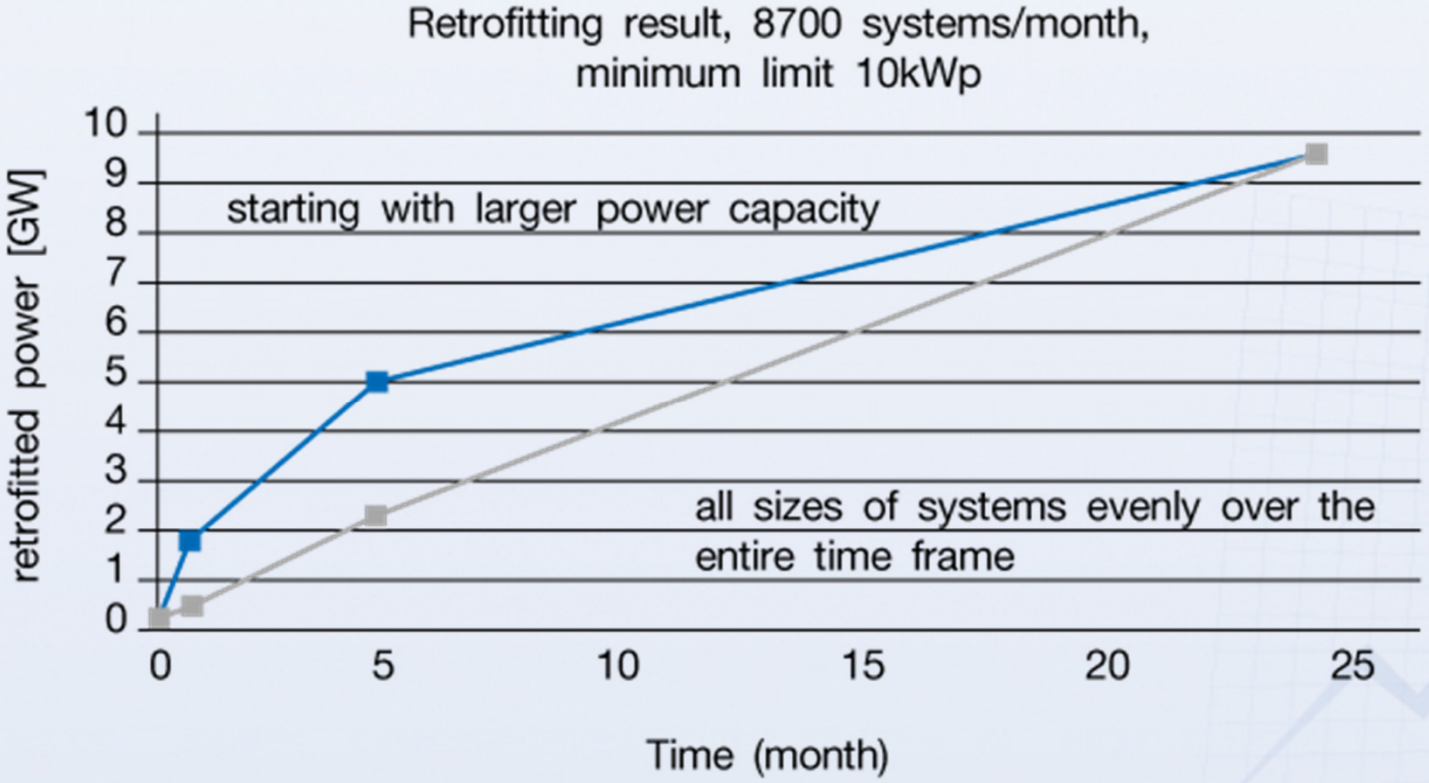
"set base"

> 100 kW_p	6-12 months
> 30 kW_p	24 months
≤ 30 kW_p	24-48 months

about 3 years

8,500 to 11,000 units per month

Scenarios for Implementation, Retrofitting Time Period 3 Years



Standby Systems

- Purpose: Ensuring the supply of the subnetwork during maintenance work in the low voltage distribution network
- Obligation of the network operator: Maintain reliability of supply for the end consumers
- *High complexity* of technical phenomena is to be sufficiently considered for solutions regarding the "50.2-Hz Problem" and is an important framework condition.
- Requirement: there is also a need for adjustment with standby systems of distribution network operators.

Overview of costs

Total costs	€
Retrofitting of photovoltaic systems	EUR 65 … 175 million
Retrofitting of standby systems	up to about EUR 2 million
Additional costs, e.g. management of distribution network operators, photovoltaic-inverter manufacturers	still open

Summary of the Study

- Appropriate technical measures are identified.
- Goals in doing so: technically effective, cost-efficient, smallest possible amount of expenditure and quick implementation.
- Statements presented about possible implementation time frame and budget.
- There is an effective concept for ensuring system stability.