Grid management functions – Inbuilt within SMA inverters
How much PV-power does the German grid support?

Week of maximum PV yield in Germany 2005

PV power is peak load power

“Dynamic investigation into the correlation between PV feed-in and grid load fluctuations”
Partial result of the study “The role of solar power production in future energy supply structures – value of solar power”
PV can be integrated in the power grid and can actively support grid stability

- Instruments for grid stabilisation and grid support:
  - Grid Stability Management
  - Reduction of active power in cases of over-frequency
  - Ability to supply/absorb reactive power during PV operation
  - Ability to supply/absorb reactive power during night
  - Ability to control cos phi / VAR
  - Stay connected during grid failures (FRT limited)
  - Delivers reactive current in cases of failure

- Sunny Central CP meet the **requirements of grid support** worldwide

- With an increasing share of renewable energies in the grid, PV must make a **contribution to grid support**
Tools for grid management: Generation Control

- Manage temporary generation/load imbalance conditions in local grid sector
- Limit power generation via remote control with the SMA Power Plant Controller via the Cluster Controller or the SC COM
- Available for all SMA inverters of SC and STP series
Tools for grid management: Frequency Control

- Temporary reduction of generated power depending on frequency
  - in case of emergency
  - in case of generation/load imbalance
  - to avoid instability
- Available for all SMA inverters of SC, SMC and STP series
- Also available for most SMA inverters of the SB series
Tools for grid management: Voltage Control

- Feed-in of **active power** has influence on voltage (voltage rise)
- **Voltage rise can be compensated** via feed-in of **reactive power**
- Available reactive power modes:
  - $\cos \Phi = \text{const.}$ (constant setting acc. to application requirement)
  - $Q = \text{const.}$
  - $\cos \Phi (P)$ (automatically adjusted according to power level characteristic)
  - $Q(V)$
- Available with SMA inverters of SC xxxHE-11, SC xxxCP and STP series
- **Influence on dimensioning of inverters**
Tools for grid management:
Dynamic Grid Support (fault ride through FRT)

> Generating facility must not disconnect during voltage fault!

> Required behavior:
  > Above „Limit 1“
    → Continuous, stable operation
  > Between „Limit 1“ and „Limit 2“
    → May disconnect in accordance with grid operator
  > Below „Limit 2“ and below 30% $V_{nom}$
    → May disconnect

Source: German technical guideline for generating plants connected to the medium voltage grid. BDEW, June 2008
Tools for grid management: Full Dynamic Grid Support

- Provide short circuit current during voltage fault
- Limits the influence of voltage faults (dips) in transmission lines on the grid
- Prevention of
  - Simultaneous disconnection of large generating facilities
  - Blackouts!
- Available with SMA inverters of SC xxxHE-111, SC xxxCP and STP series
- No influence on dimensioning of inverters

Source: German Transmission Code 2007
Grid management: A sophisticated Plant Control System is needed

Why is a Plant Controller needed?

> In large-scale PV installation it is not possible to control the PV park behaviour at the point of interconnection (POI) by a single inverter
> The inverter usually has no information about the electrical conditions at the Point-of-Interconnection
> Between the inverters and the POI there are distances of up to several km
> Cables and transformer influence the electrical behavior between inverter and Point-of-Interconnection

A controller is needed to read actual values at the POI, receive set points from a supervisory control (utility) and to control the inverters
Summary: The role of photovoltaic energy in power generation

> PV and SMA inverters provide **ideal conditions** for **grid integration**

> **Local generation**, close to consumer

> Provides **peak load** power

> **Grid stabilisation** has to go hand in hand with the expansion of photovoltaic power plants

> Requirements must be adjusted to **plant size** and **voltage level**

> The **integration** of renewable energy sources into **grid management** allows for the **unlimited access of renewable energy** to the grid
PV Plants Throughout the World – Brandis (Germany)
PV Plants Throughout the World – Montalto di Castro (Italy)
PV Plants Throughout the World – Sarnia, ON (Canada)
PV Plants Throughout the World – Lieberose, (Germany)
"A first step towards more independence"
Thank you for your attention!