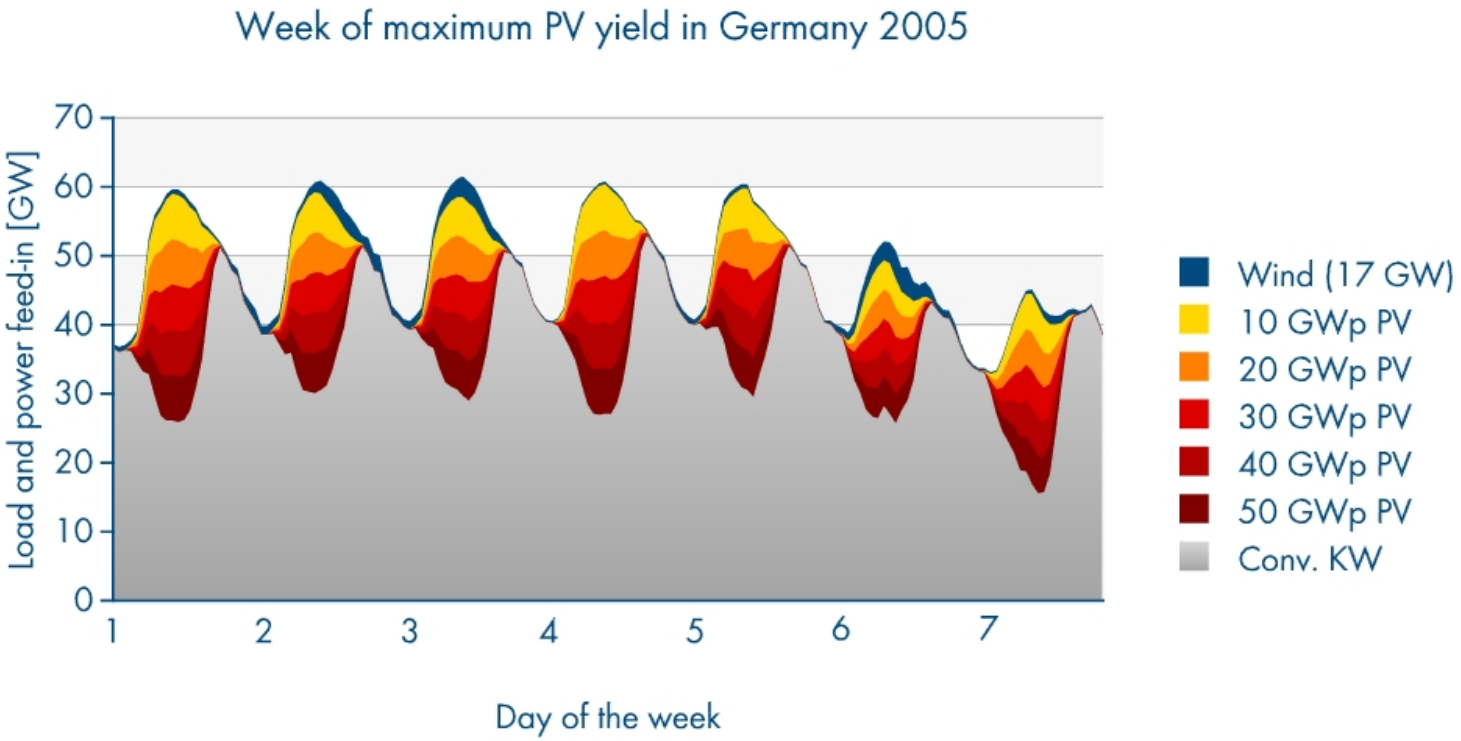
Grid management functions – Inbuilt within SMA inverters

Andros Cadavid Rojas, Sydney, 26th of November 2013

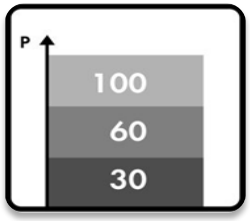
How much PV-power does the German grid support?

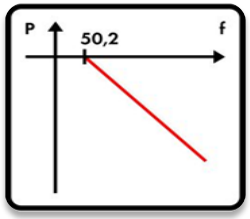


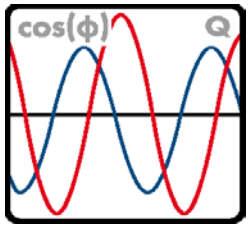
- **PV power is peak load power**

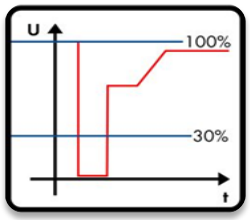
"Dynamic investigation into the correlation between PV feed-in and grid load fluctuations"
Partial result of the study "The role of solar power production in future energy supply structures – value of solar power"

PV can be integrated in the power grid and can actively support grid stability







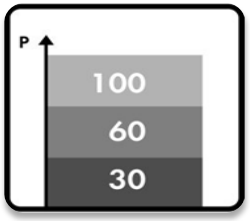


> Instruments for grid stabilisation and grid support:
>> Grid Stability Management ✓
>> Reduction of active power in cases of over-frequency ✓
>> Ability to supply/absorb reactive power during PV operation ✓
>> Ability to supply/absorb reactive power during night ✓
>> Ability to control cos phi / VAR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

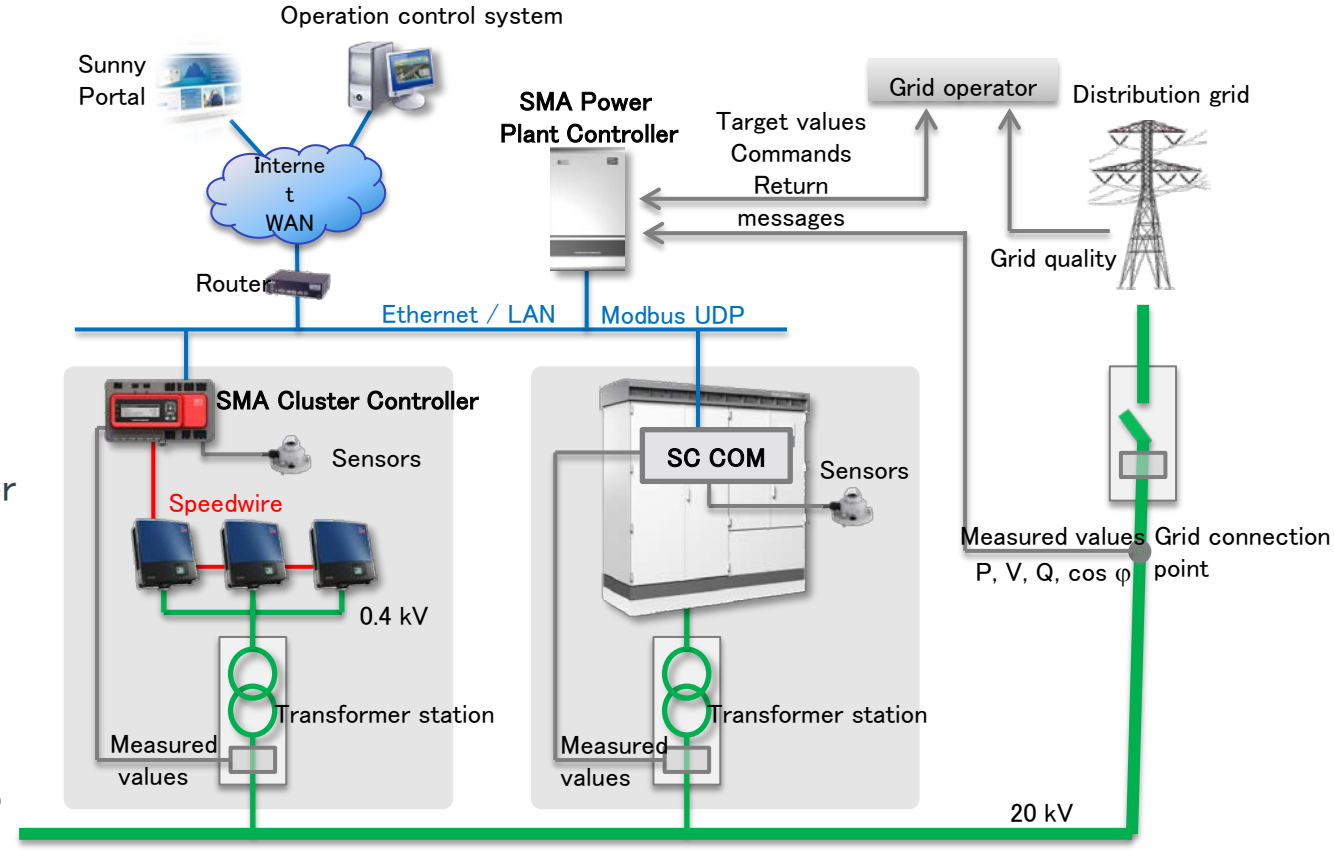
> Sunny Central CP meet the **requirements of grid support** worldwide

⏩ With an increasing share of renewable energies in the grid, PV must make a **contribution to grid support**

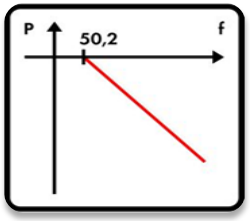
Tools for grid management: Generation Control



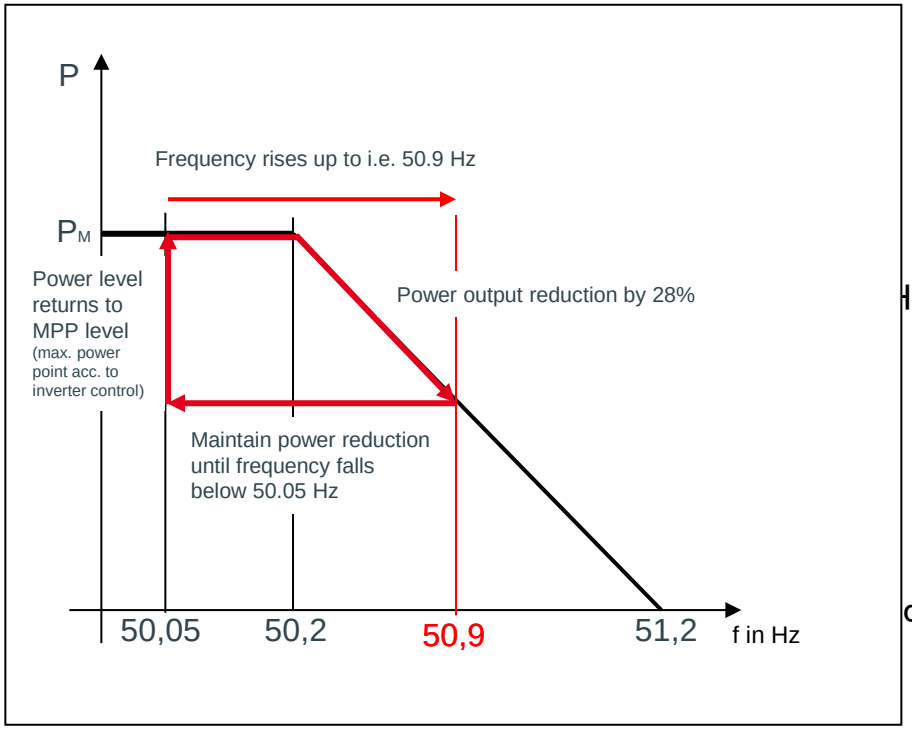
- Manage temporary generation/load imbalance conditions in local grid sector
- Limit power generation via remote control with the SMA Power Plant Controller via the Cluster Controller or the SC COM
- Available for all SMA inverters of SC and STP series



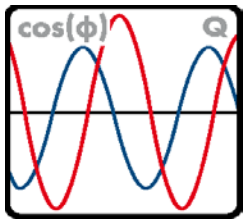
Tools for grid management: Frequency Control



- 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

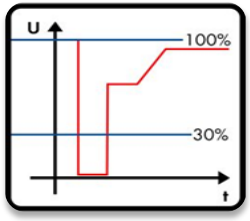


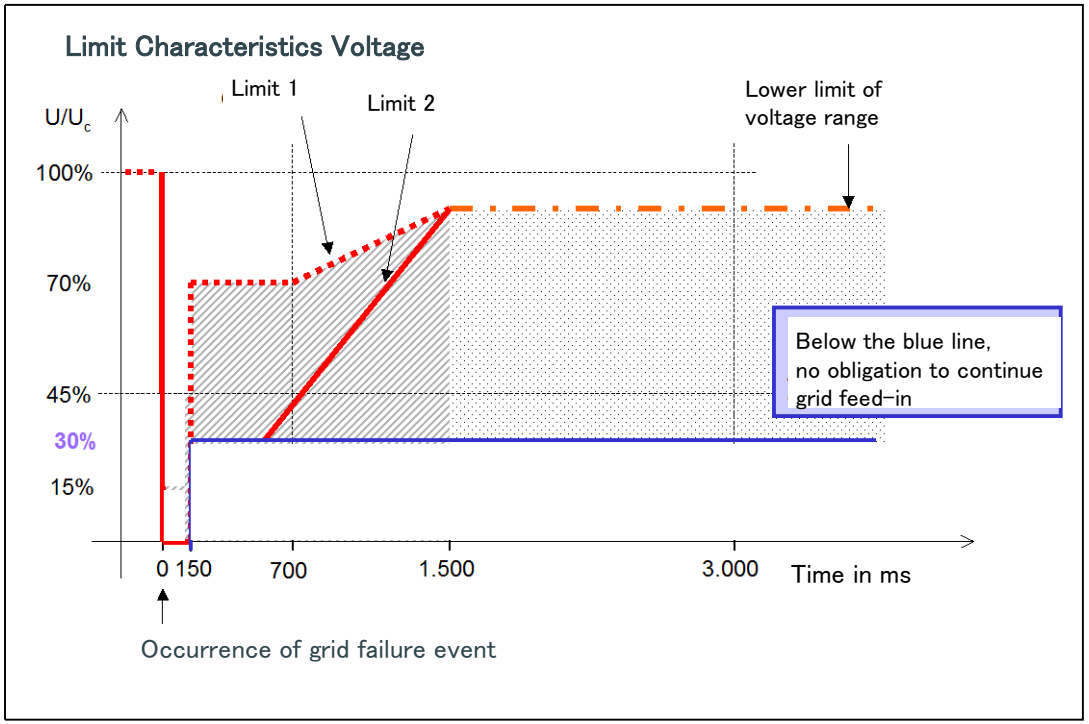
Tools for grid management: Voltage Control



- 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 = const.** (constant setting acc. to application requirement)
  - **Q = 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)

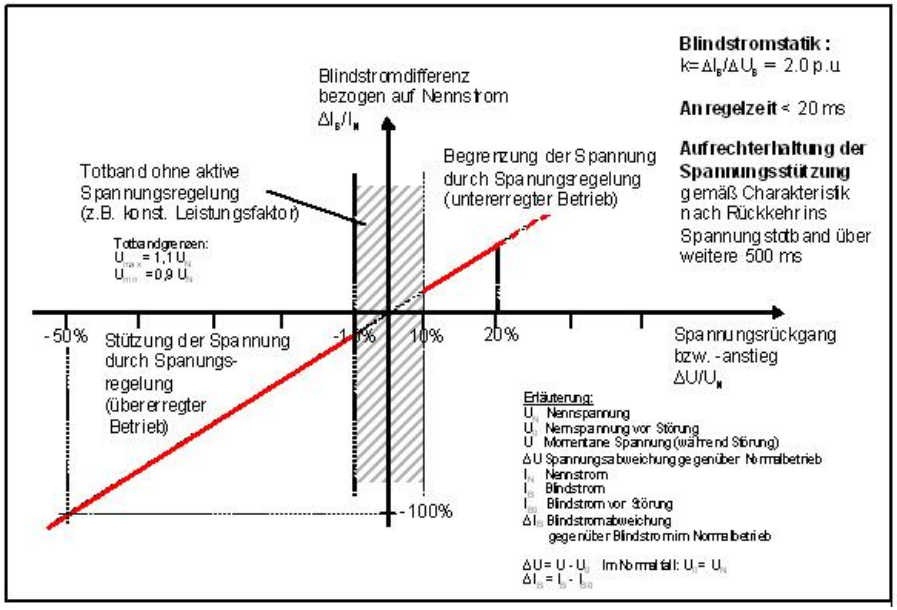




- Generating facility **must not disconnect** during voltage fault!
- Required behavior:
  - Above „Limit 1“ → Continuous, stable operation
  - Between „Limit 1“ and „Limit 2“ → May disconnect in accordance with grid *operator*
  - Below „Limit 2“ and below 30% V_{nom} → May disconnect

Source: German technical guideline for generating plants connected to the medium voltage grid. BDEW, June 2008

Tools for grid management: Full Dynamic Grid Support



Source: German Transmission Code 2007

- 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-11[1], SC xxxCP and STP series
- **No influence on dimensioning of inverters**

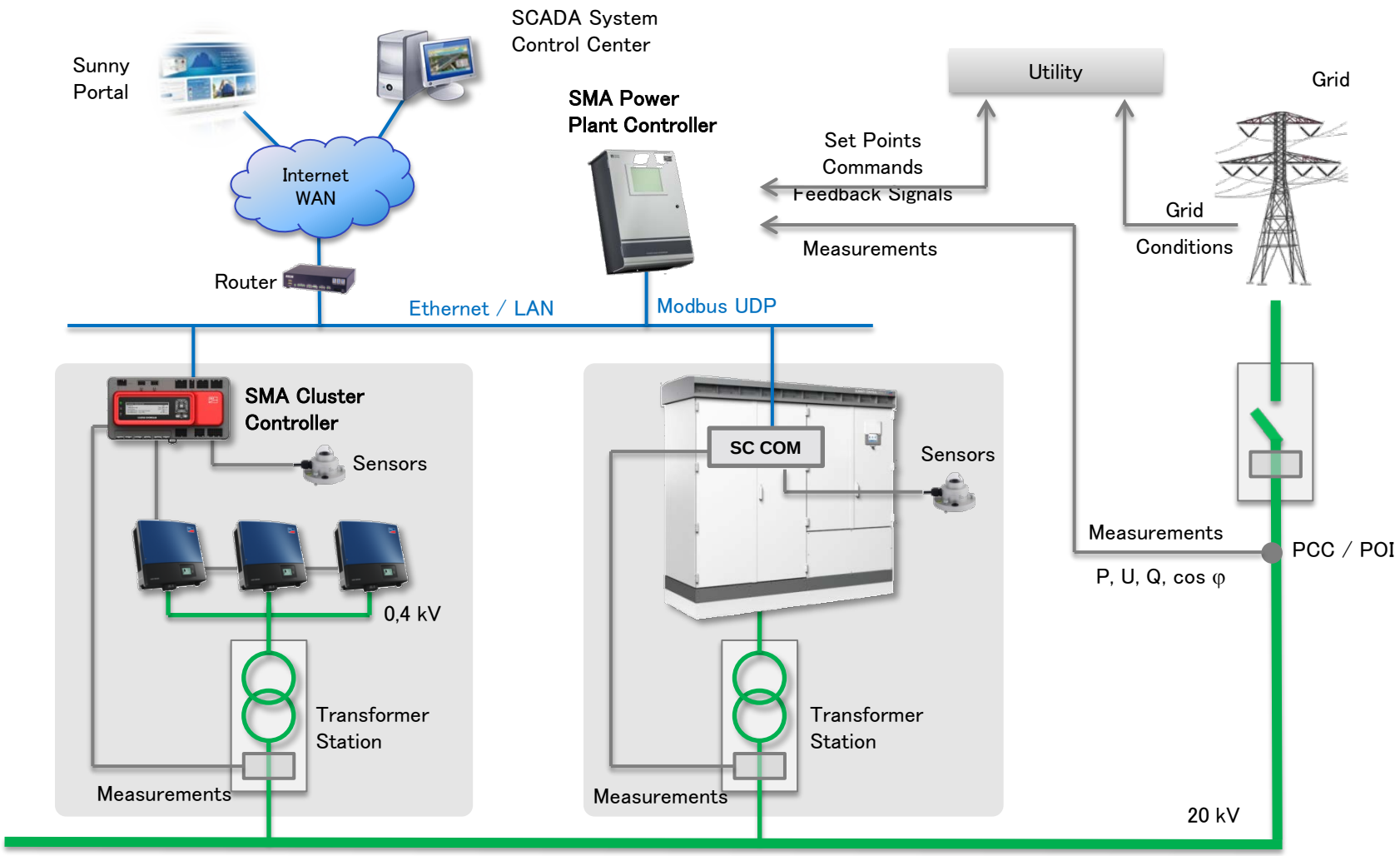
Grid management: A sophisticated Plant Control System is needed

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

SMA Plant Control System – overview



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)


SMA
"A first step towards more independence"

Thank you for your attention!