CHALLENGES AND SOLUTIONS IN POWER QUALITY – EXAMPLES FROM INDUSTRY AND PUBLIC DISTRIBUTION NETWORKS

AIT Industry Day 2015

11.09.2015, Dr.-Ing. Thomas Smolka

COMPANY PROFILE OF MR – BU FOR POWER QUALITY FOCUSED ON CUSTOMER BENEFITS

Goal

Increasing corporate value in global niches of electrical power engineering while preserving our independence

Vision

Marketing of proprietary technologies			No transformers without a MR product		Preferred system integrator	

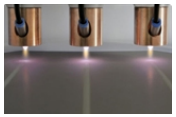
Range

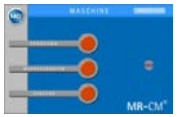
REINHAUSEN PLASMA Surface Modification and Powder Coating	REINHAUSEN CAM Decision Support for Manufacturing Excellence	POWER COMPOSITES Composite Materials and Insulators	MESSKO INSTRUMENTS Equipment Control and Assessment	TRANSFORMER CONTROL Control of Power Transformers	POWER QUALITY Solutions at Grid Nodes	HIGHVOLT TESTING Testing and Measurement Technologies

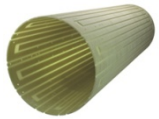
Task

Surface Activation for Industrial Processes Functional Coatings by Plasma Technology	Integration of Shop Floor Data Models into ERP Optimization of Automated Manufacturing Processes	Mechanical & Electrical Endurance by GFRP Composite Insulators for HV / MV Equipment	Sensors, Accessories, Oil Analytic Laboratory and Secondary Brands Process Measuring and Control Technologies for Industry Applications	Actuators, Electronics and Data Management Transformer Services	Filters and Reactive Power Compensation Power Flow Control in Distribution Networks	Shop Floor Testing Systems for Grid Components Mobile HV / MV Systems for On-Site Testing

Products









Brand

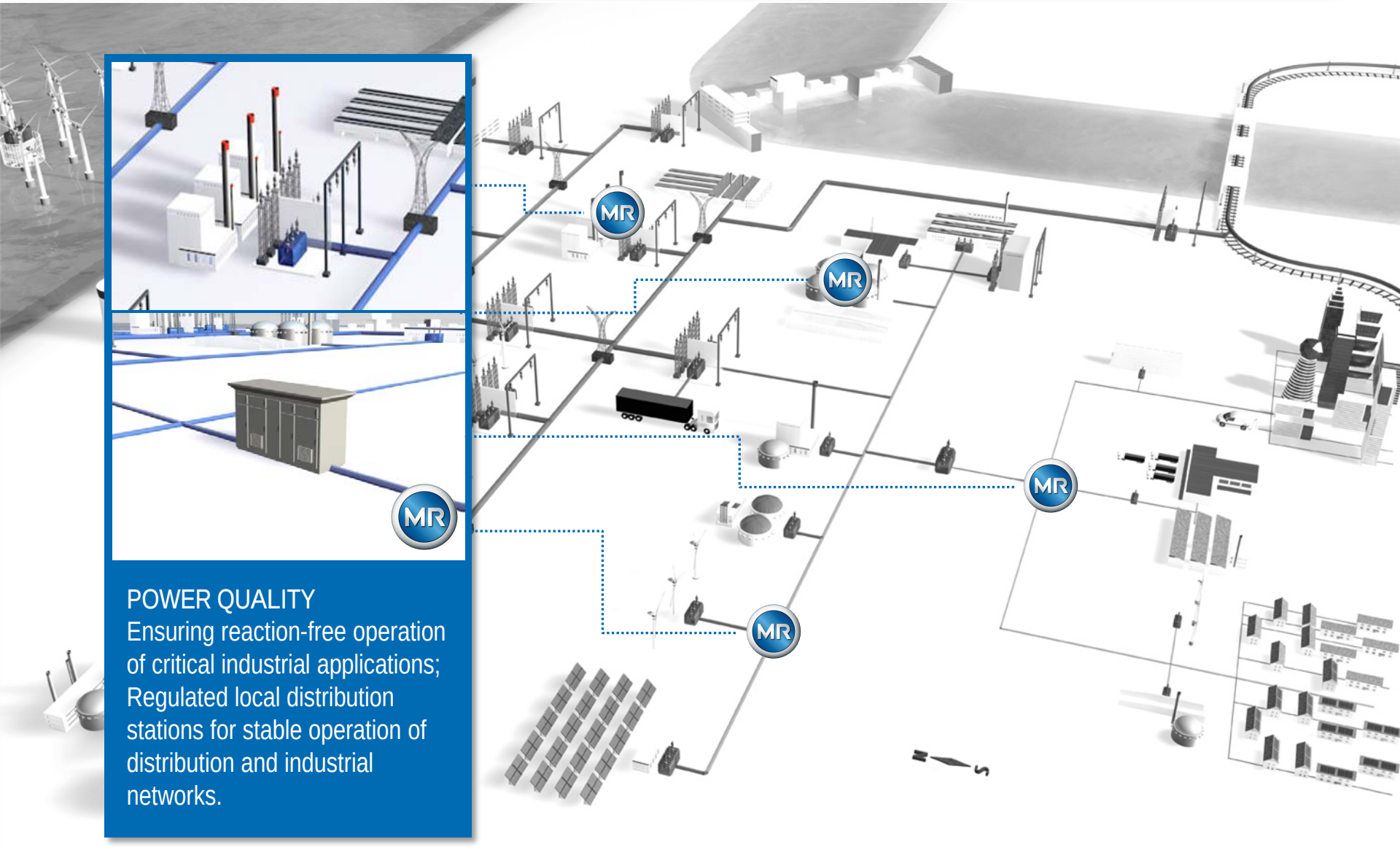
reinhausen plasma

THE POWER BEHIND POWER.

www.reinhausen.com

HIGH VOLT

POWER QUALITY SOLUTION BUSINESS @ MR
PROJECT BUSINESS AT THE POINT OF COMMON COUPLING



POWER QUALITY
Ensuring reaction-free operation of critical industrial applications; Regulated local distribution stations for stable operation of distribution and industrial networks.

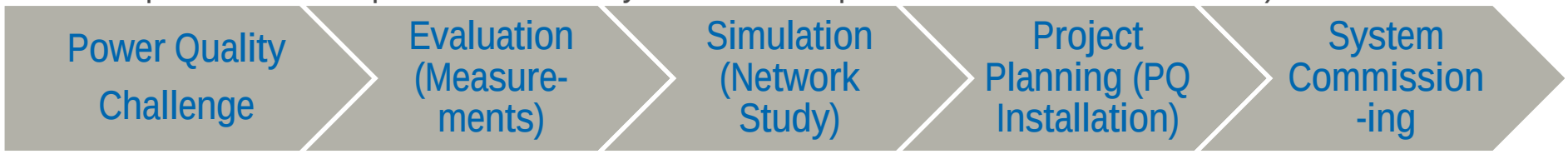
PROJECT BUSINESS APPROACH POWER QUALITY

Integrated consulting approach for complex Power Quality solutions

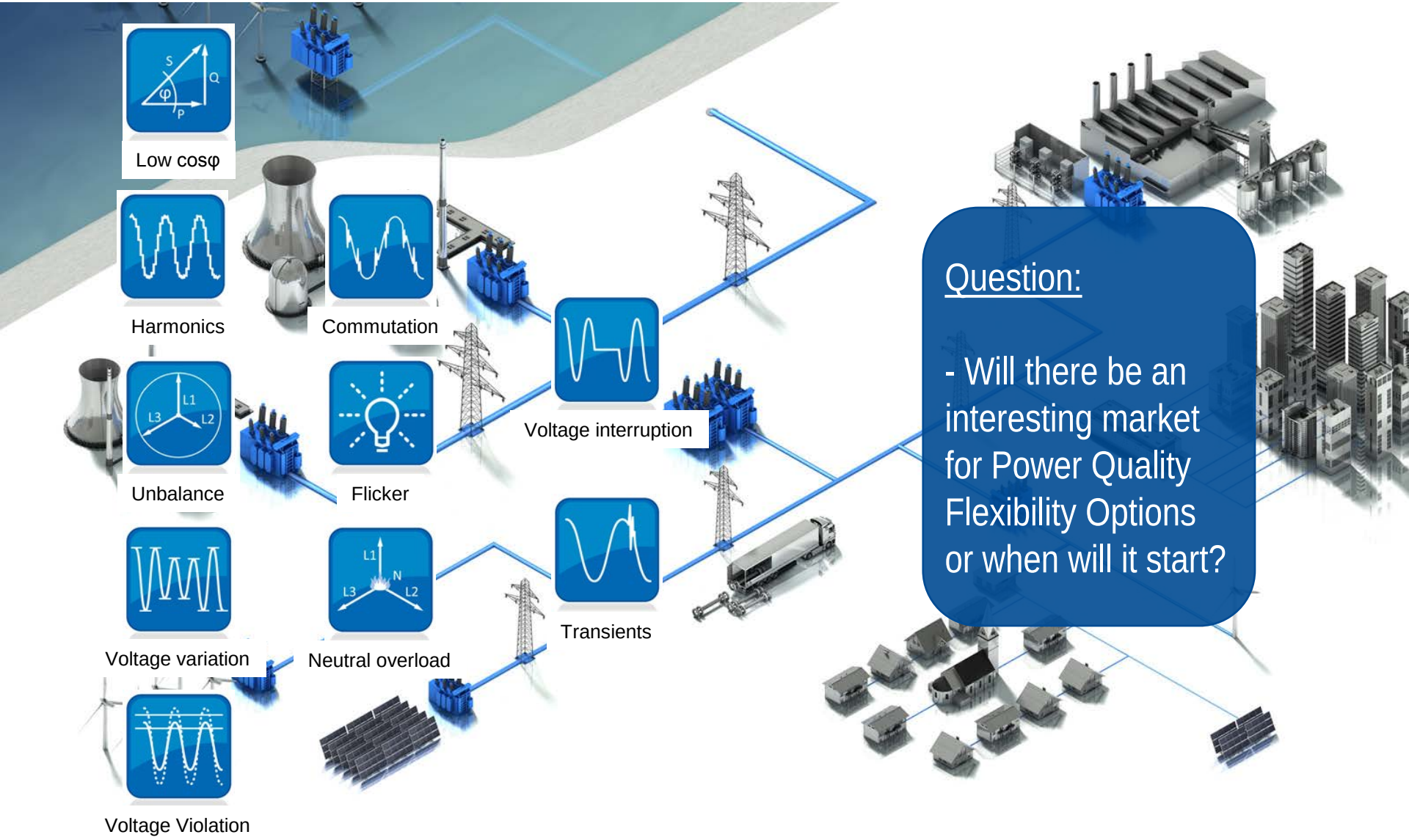
- PQ is a solution partner for customers in case of Power Quality Issues (e.g. shutdown of production facilities, harmonices, etc.)
- PQ gives support from the analysis of the problem to the commissioning of the technical installation (compensation plant etc.)

Advantages for the customer

- highest staff competence by long lasting experience in PQ project business – in practice and theory – from simulation, planning, installation and service
- Fullfilment from beginning until project installation (incl. service)
- Not bounded to own product portfolio -> best economical and technical solution for the customer
- long refernce list by world-wide experience in complex PQ projects (renewable energy parks, offshore platforms, industry installations, public distribution networks…)



POWER QUALITY CHALLENGES AT THE POINT OF COMMON COUPLING (PCC)

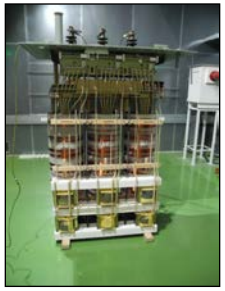


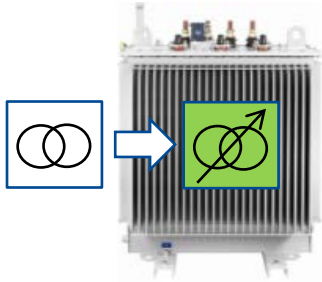
Question:

- Will there be an interesting market for Power Quality Flexibility Options or when will it start?

Solutions at the Point of Common Coupling (PCC)

Trends:
- Change from passiv compensation systems to active systems (Active Filters, SVC, STATCOM…)
- Standard Solutions for Voltage Regulation of Distribution Transformers available

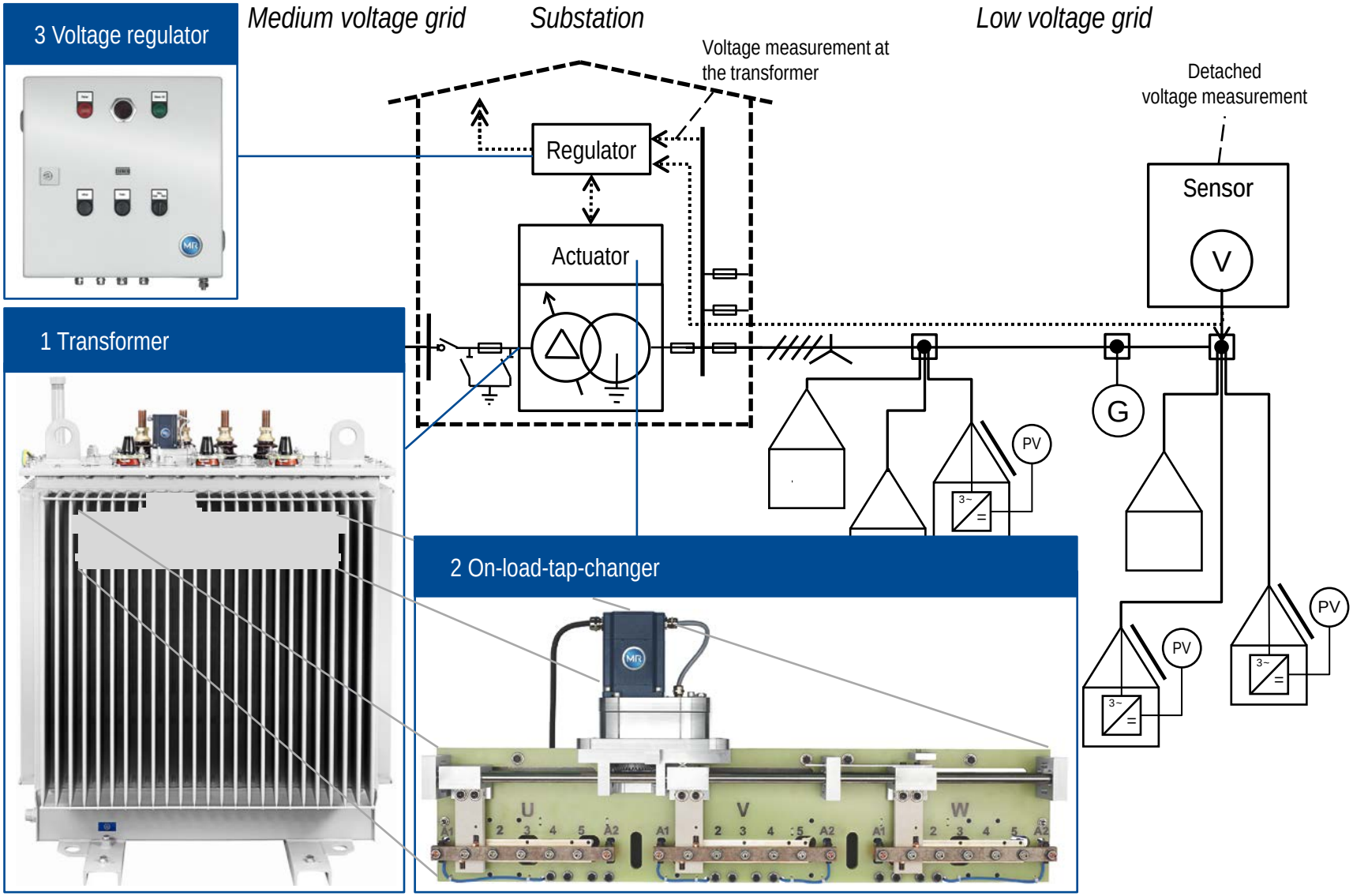




- Passive Inhouse Compensation Systems
- Dynamic Systems Static Var Compensator (SVC)
- Variable Shunt Reactor
- Voltage regulated Distribution Transformer (VRDT)
- Passive Systems with SKID
- Dynamic Systems: SVC, STATCOM and Active Filters

Application Fields for Power Quality Solutions at the PCC

EXAMPLE 1:
VOLTAGE REGULATED DISTRIBUTION TRANSFORMERS (VRDT)



EXAMPLE 1: GRIDCON® iTAP® - MAKING VOLTAGE REGULATION IN DISTRIBUTION GRIDS REALITY (VRDT)

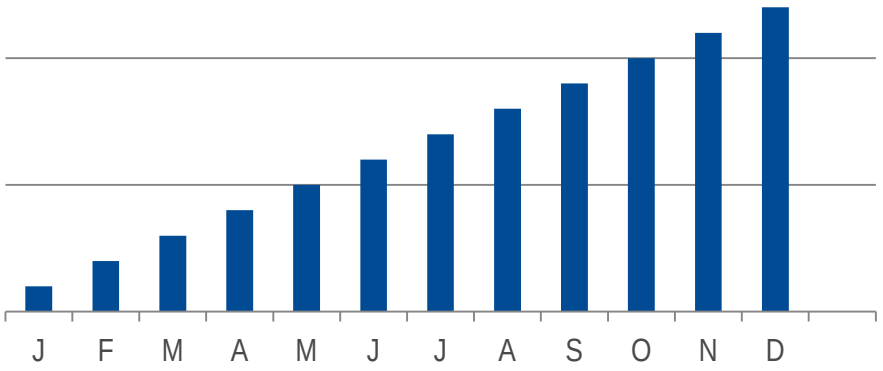
2012 | 2013 | 2014 | 2015 | 2016

Produkt launch

- GRIDCON® iTAP® is presented in 09/2012
- The first transformers with GRIDCON® iTAP® go live

Market success

- More than 600 transformers with OLTC GRIDCON® iTAP® are operated in distribution grids around the world
- FGH certifies a transformer with GRIDCON® iTAP®
- First DSOs as E.ON Subsidiaries and EWE Netz GmbH defined VRDT as standard solution for voltage regulation



Upgrade:

- New and improved features make GRIDCON® iTAP® even better

Add-ons:

- New and improved products complement GRIDCON® iTAP®

EXAMPLE 1: NEW AND IMPROVED FEATURES MAKE VRDT WITH GRIDCON® ITAP® EVEN BETTER

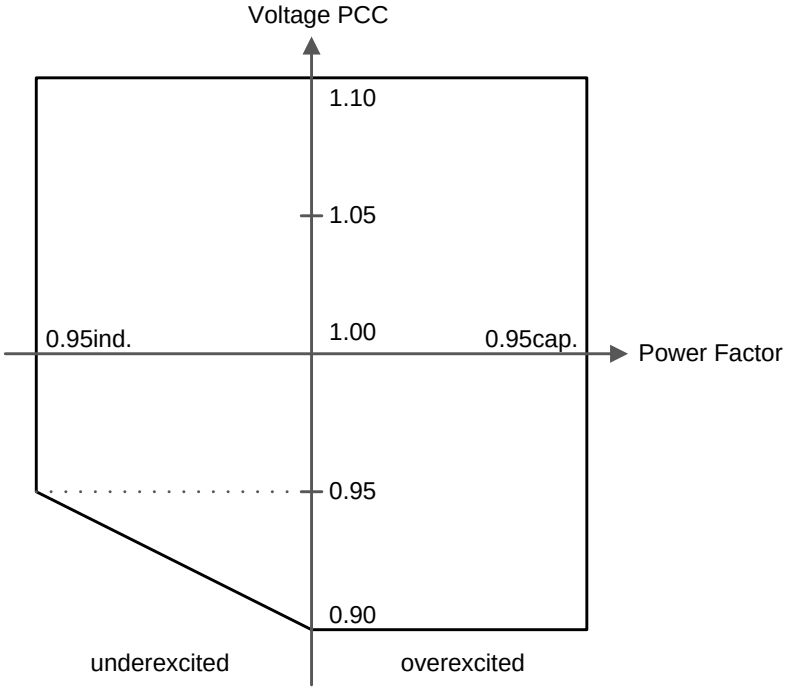
1. 2nd version: Rated through current of up to 85 A VRDT available up to 4.500kVA (24kV)
2. Advanced voltage control algorithms:
   - Dynamic voltage set point based on assessment of measured power or current
   - Remote sensor measurement voltage control
   - Holistic grid-wide voltage control relying on multiple remote sensors
3. Operating mode without additional losses from reactors*
4. MODBUS TCP support
5. Extended data points for IEC 60870-5-104
6. Advanced measurement and logging of power quality data
7. Approved for alternative insulating liquids
8. Approved for outdoor use**

*Reduces number of positions to 5; stops in bridging positions with losses for short period of time; **Motor only, control cabinet needs to be housed

Note: Some features at extra charge

EXAMPLE 2: VARIABLE SHUNT REACTOR FOR PV PARK CHALLENGE - GRID CODE REQUIREMENTS IN GERMANY

Reactive Power Infeed acc. BDEW MV Grid Code

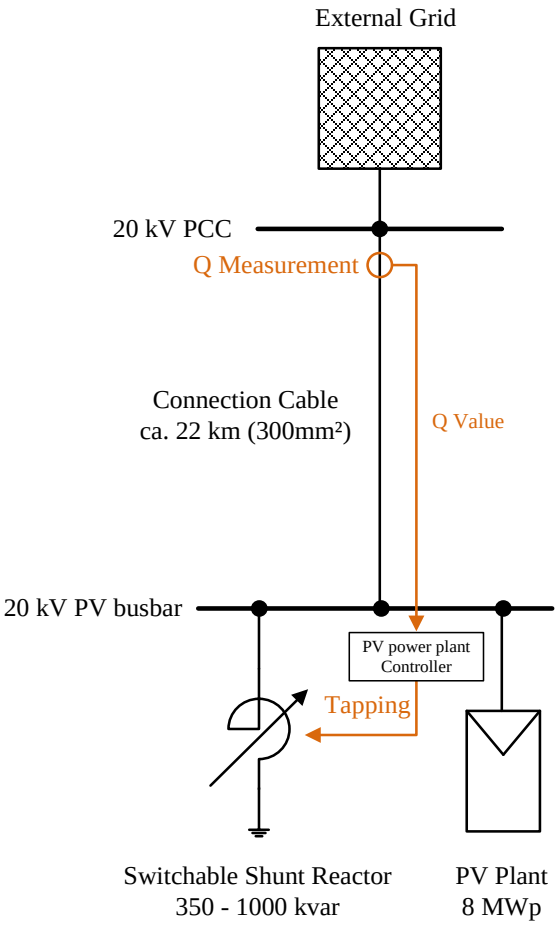


Source: BDEW MV Grid Code

- in Germany new **requirements** for the **adjusting range of the reactive power** are obligatory since 01.01.2014
- New renewables-based plants in Germany mustn´t be connected to the grid without a certificate which proves the network conformity

Power range of PV power plant	**Voltage range**	**Requirement at PCC**
0 – 10 % of the rated power	±10 % of rated voltage V_N	less reactive power infeed than 10 % of the contractually agreed active connection power
10 – 100 % of the rated power	±10 % of rated voltage V_N	variable power factor in the range from 0.95cap to 0.95ind

Case Of Application – Large-Scale PV Power Plant



PV power plant

- Voltage level: 20 kV
- Rated power: 8000 kWp
- Connection cable: 22 km / 300 mm² standard cable

VSR

- Voltage level: 20 kV
- Switching principle: OLTC based on reactor principle
- Numbers of OLTC: 2 (series-connected)
- Rated power 1000 kvar
- Inductive power range: 350 up to 1000 kvar
- Operating positions: 13 (45 up to 65 kvar inductive)

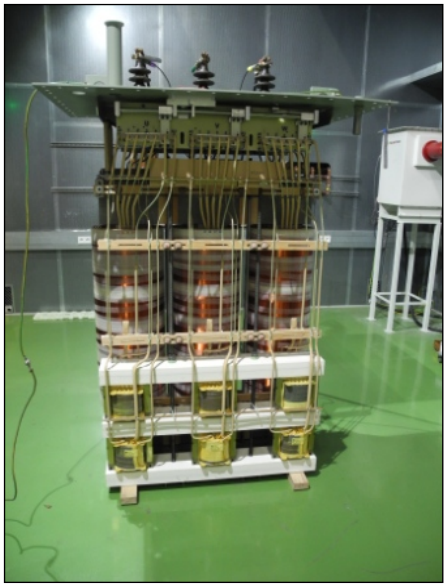
EXAMPLE 2: VARIABLE SHUNT REACTOR FOR PV PARK
TECHNICAL REALISATION OF THE VARIABLE SHUNT REACTOR

Technical Data and Layout

- standard three-phase oil reactor
- variable inductance due to tappings by OLTC (GRIDCON® iTAP®)
- operating positions: 9 per OLTC (max. 13 with 2 OLTCs)
- inductive power range limits: ca. 35 % to 100 %
- implementation in concrete or metal-enclosed station

OLTCs top side of the VSR

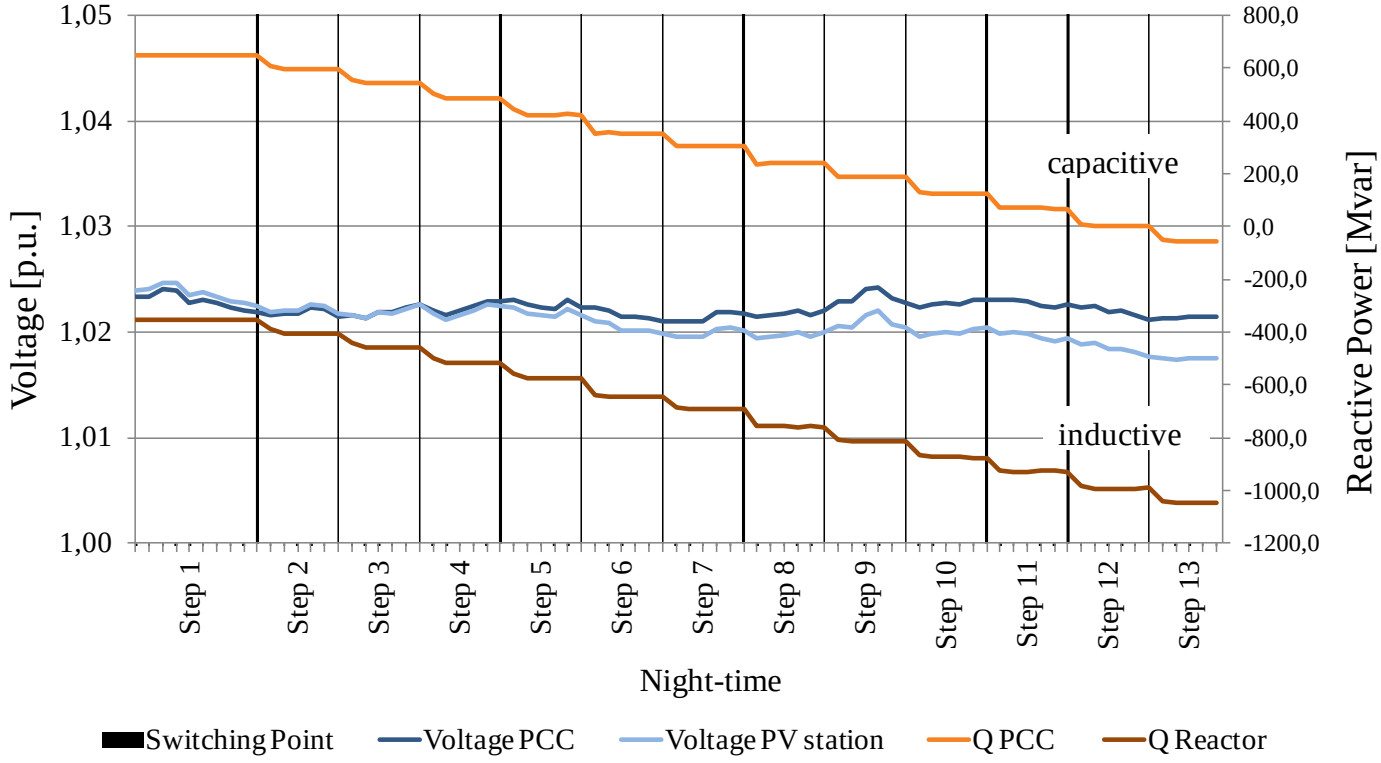
concrete station with VSR (control and protection equipment inside)



VSR in construction status

EXAMPLE 2: VARIABLE SHUNT REACTOR FOR PV PARK RESULTS

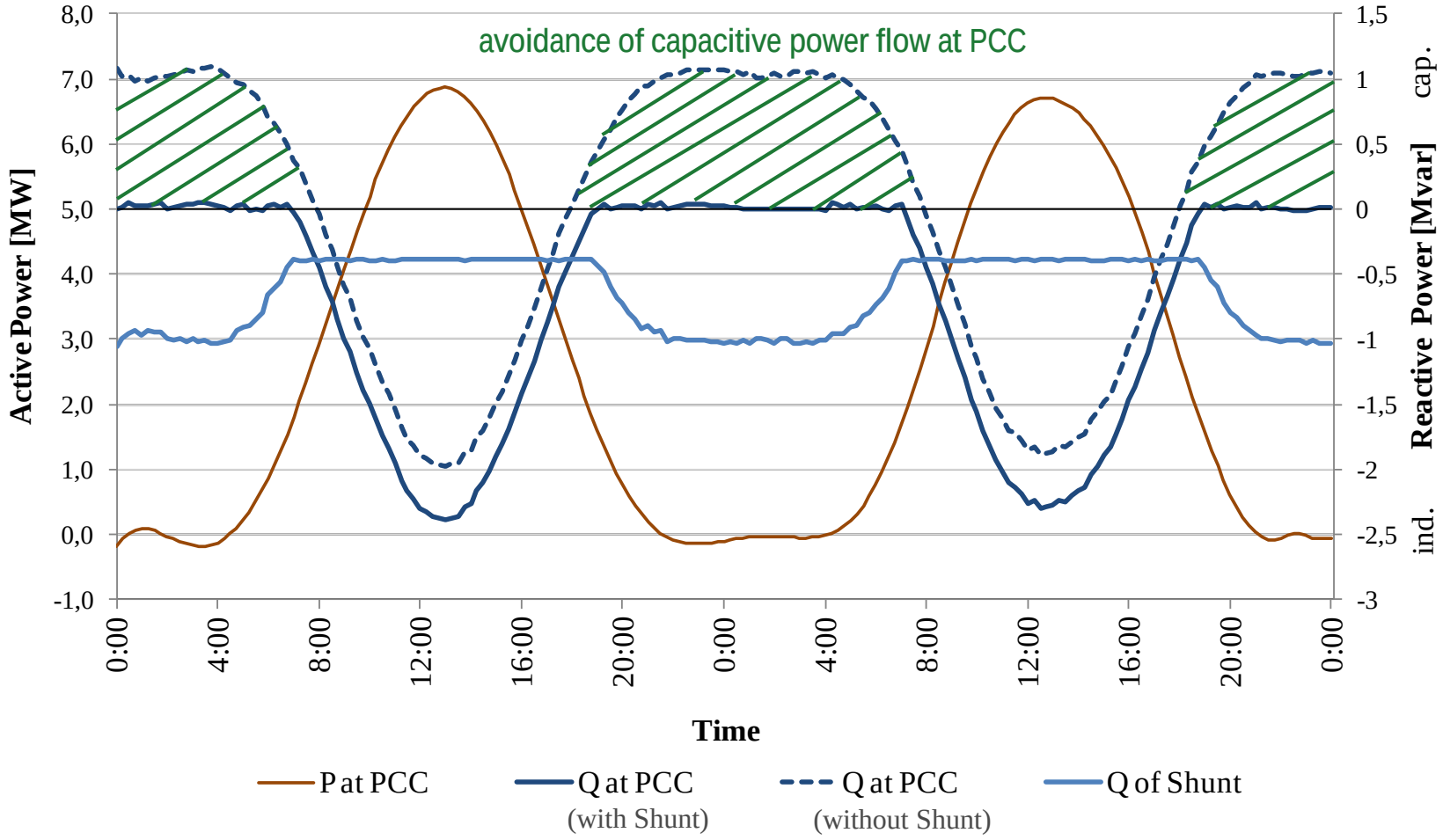
Manual Operation Of Shunt Reactor (night time)



Stepwise Change of inductive Power at PV busbar leads to

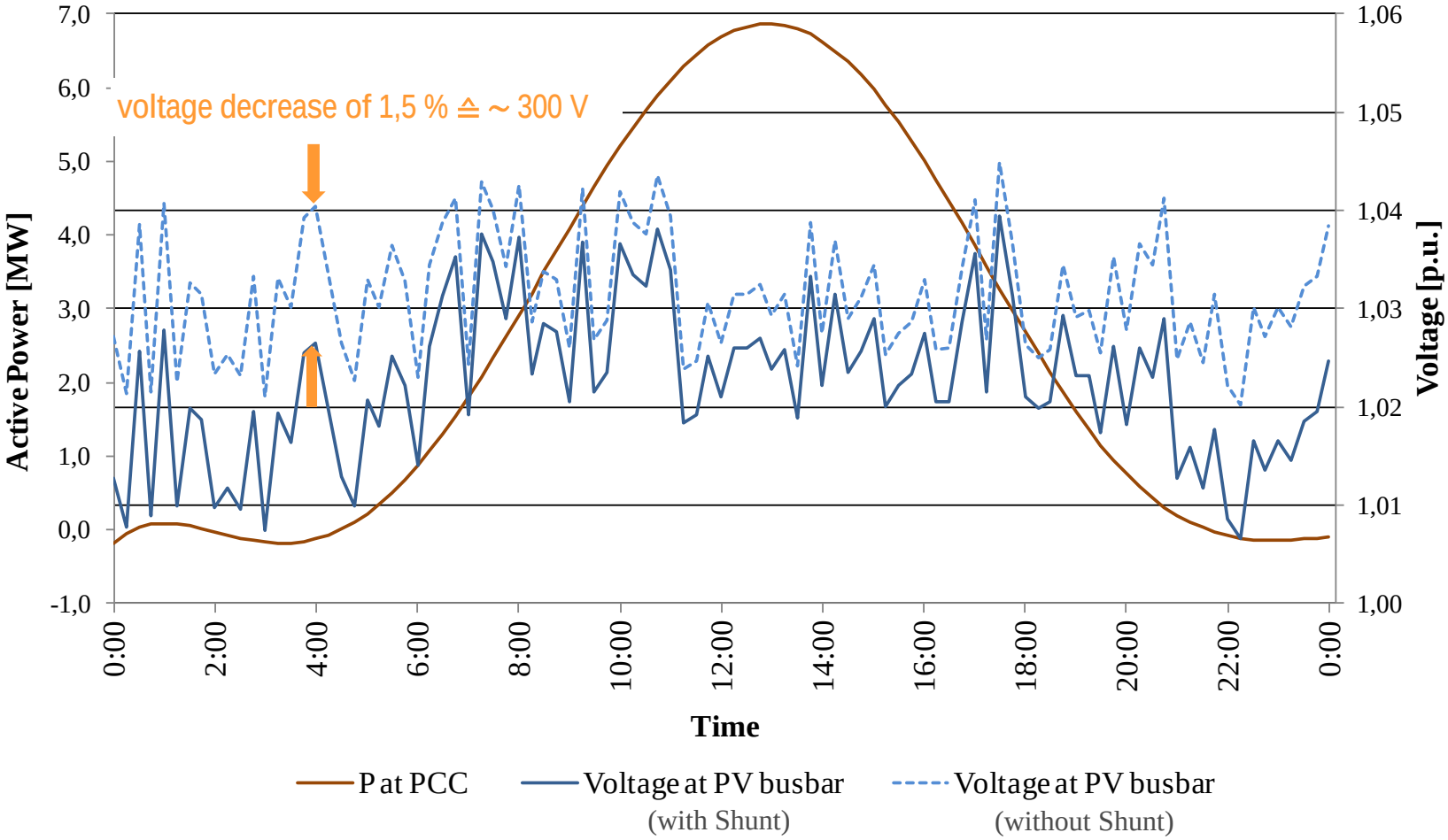
- stepwise capacitive power compensation at PCC
- prevention of voltage increase at PV busbar

Automatic Operation Of Shunt Reactor (typical summer day)



EXAMPLE 2: VARIABLE SHUNT REACTOR FOR PV PARK RESULTS

Automatic Operation Of Shunt Reactor (typical summer day)



EXAMPLE 3: ACTIVE FILTER @ MUNICH AIRPORT OPTIMIZING THD WITH GRIDCON® ACF

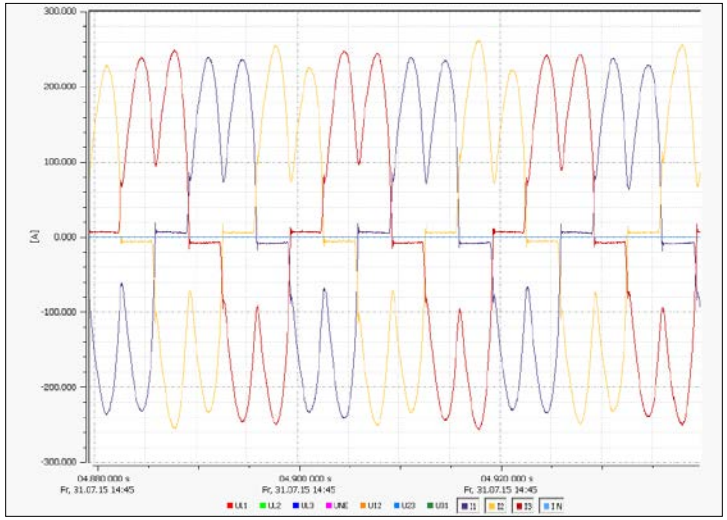
Munich Airport

Power Quality Challenge:

- Need for decentralized and efficient filtering concept
- Strict guidelines regarding service and quality must be met

Aim:

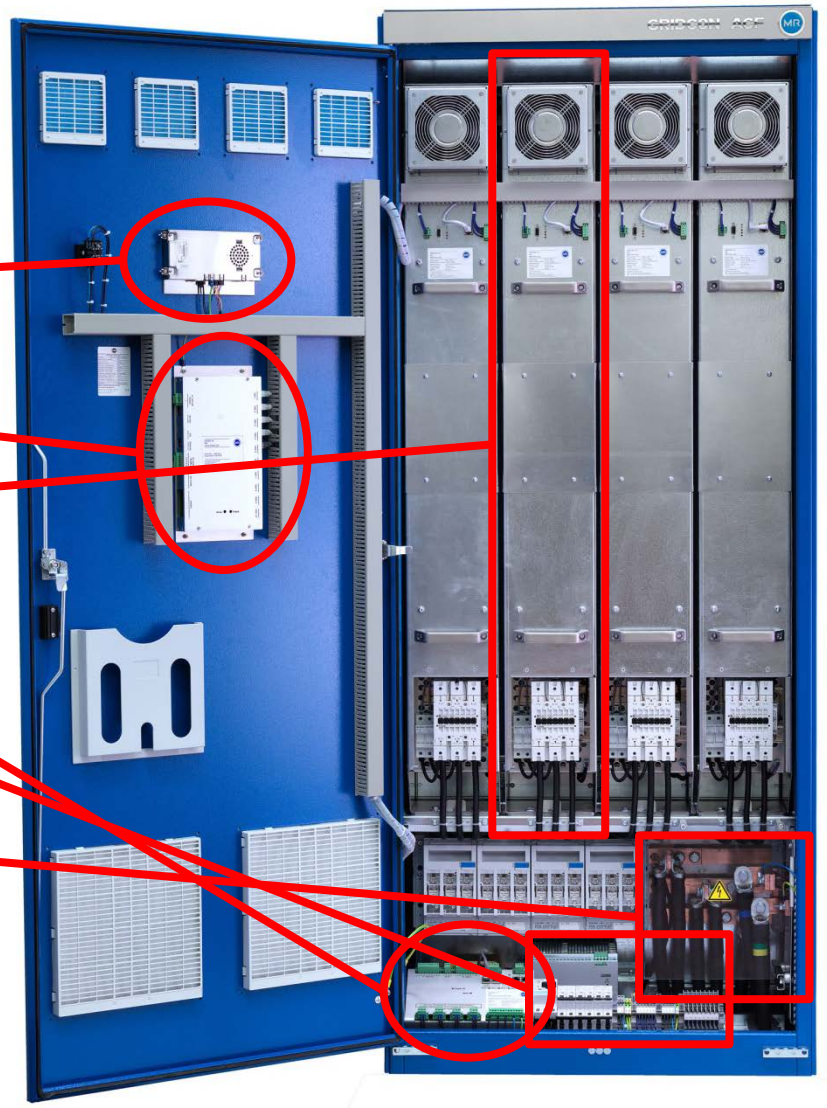
- Installations to supply aircrafts with pre-conditioned air before take-off cause non-linear current
- Without filters, the current of the air conditioning units have a total harmonic distortion (THD) of 42%
- Increased harmonics levels cannot be tolerated in an airport environment



Shape of grid current without filtering

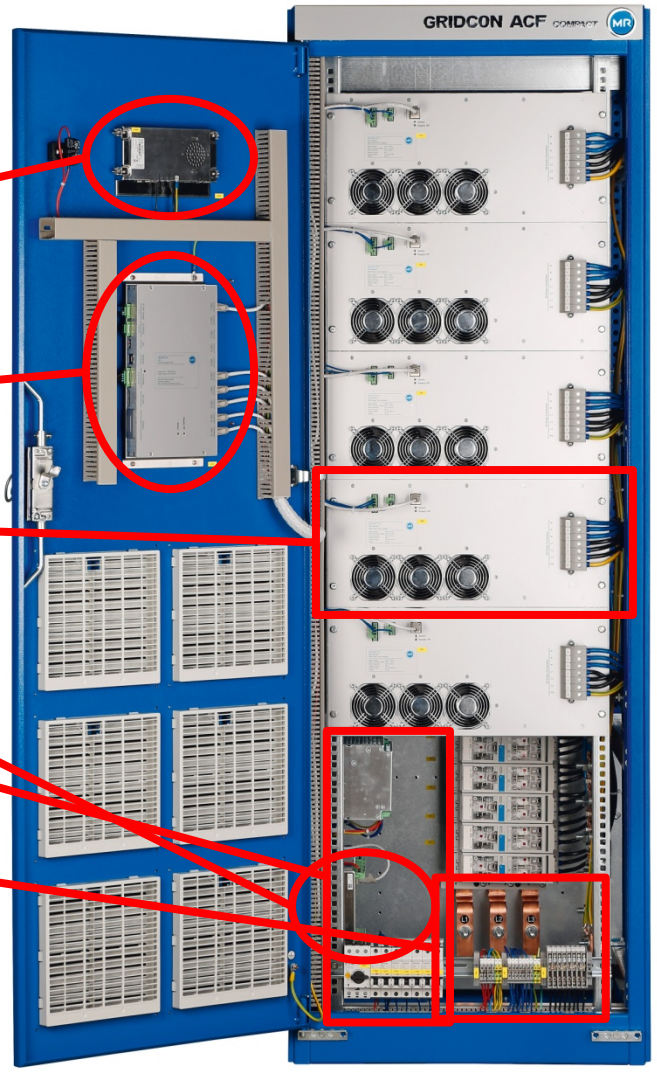
GRIDCON® ACF
Modular Active Filter

- Touch panel 7“
- Control-Computer CCU
- IGBT-Units IPU 125 A
- Measuring & I/O Unit MIO
- Control section with DC-supply
- Cabinet with cable connection



GRIDCON® ACF compact
Modular Active Filter 4-wire

- Touch panel 7“
- Control-Computer CCU
- IGBT-Units IPU 60 A
- Measuring & I/O Unit MIO
- Control section with DC-supply
- Cabinet with cable connection



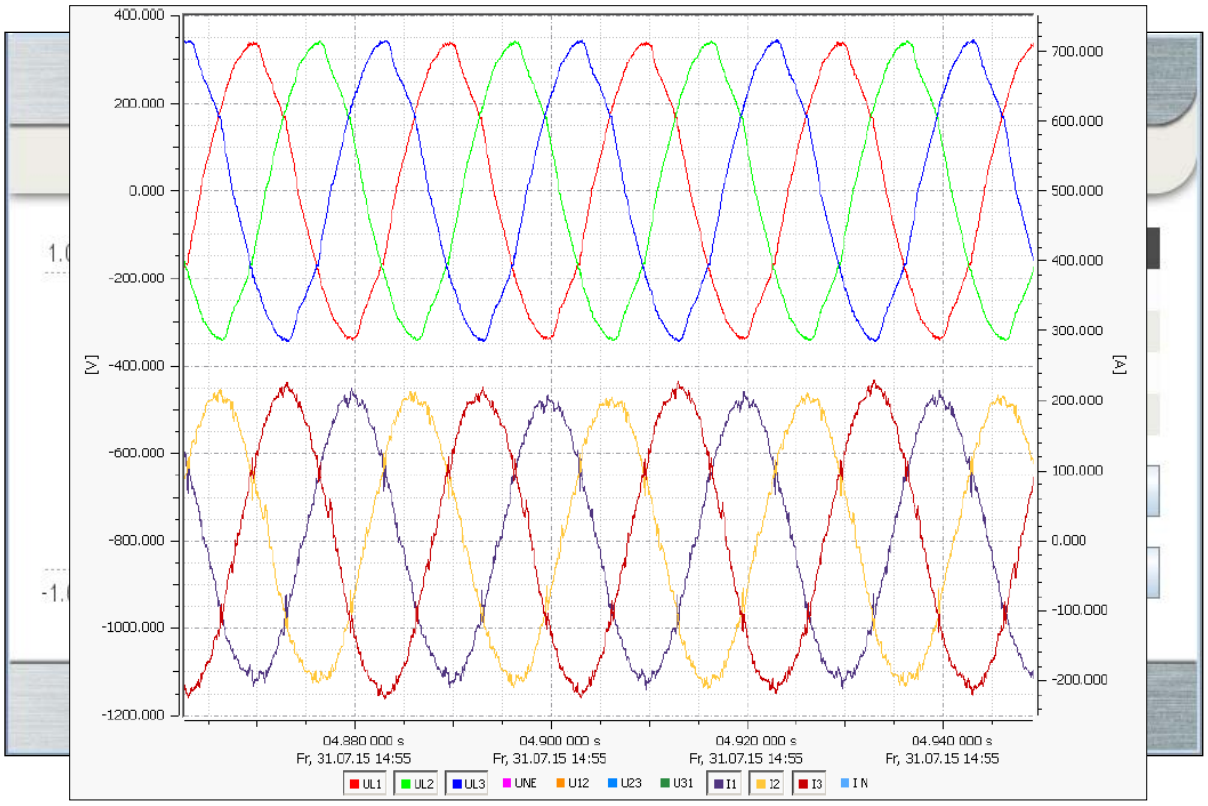
EXAMPLE 3: ACTIVE FILTER @ MUNICH AIRPORT OPTIMIZING THD WITH GRIDCON® ACF

Munich Airport

- MR is supplying 64 active filters for 4-wire connection
- GRIDCON® ACF systems are used for broad-band harmonics filtering -> THD Reduction
- The majority of filters is installed in outdoor cabinets
- Special attention was paid to a thought-through safety and service concept, which was to our benefit
- Besides, MR-PQ is taking of part of the project management as this was part of the tender

EXAMPLE 3: ACTIVE FILTER @ MUNICH AIRPORT OPTIMIZING THD WITH GRIDCON® ACF

Munich Airport:



Shape of grid current and voltage with ACF in operation

Result:

- The **total harmonic distortion** (THD) caused by unit for pre-conditioned air supply was **reduced from 42% to less than 5%** in a pilot installation

THE POWER BEHIND POWER.

www.reinhausen.com