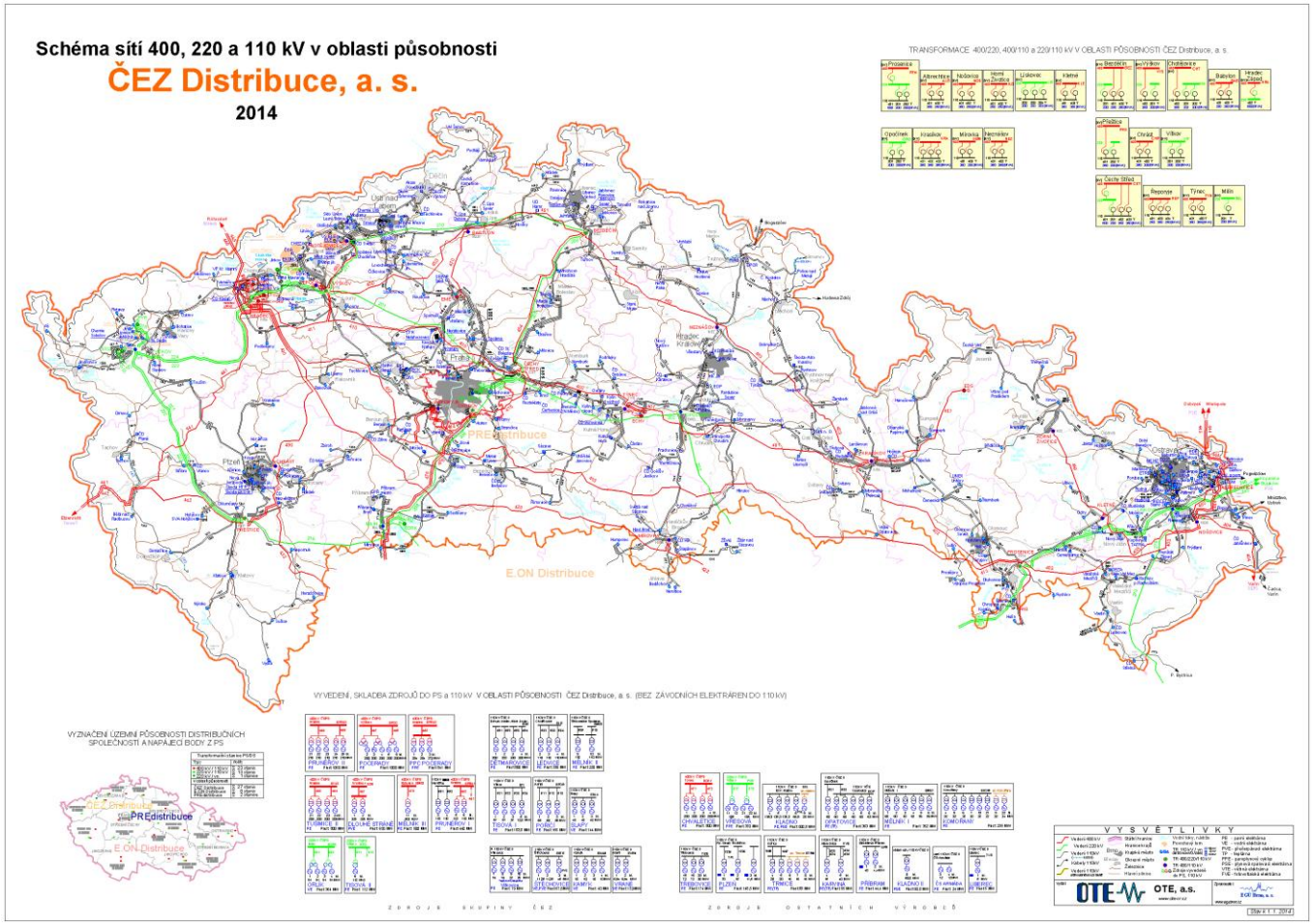
ČEZ DISTRIBUCE, A.S.

DER INTEGRATION INTO DISTRIBUTION NETWORKS (VOLT/VAR CONTROL ON MV AND LV, ACTIVE POWER CONTROL)

Ing. Stanislav Hes
Specialist for new technologies

ČEZ DISTRIBUCE, A.S. – BRIEF INTRODUCTION OF DSO



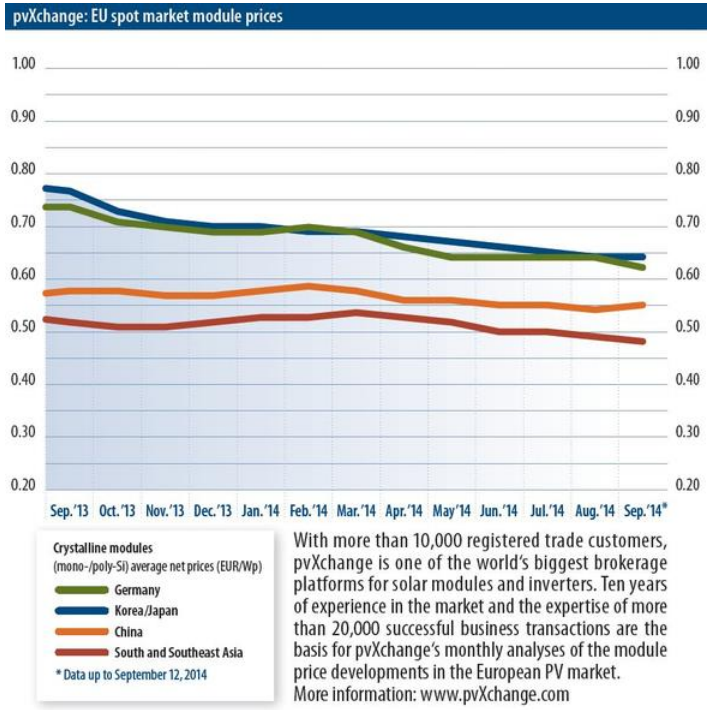
- ČEZ Distribuce, a.s. - app. 3,5 mil. customers, 230 HV/MV substations, 45 000 DTS

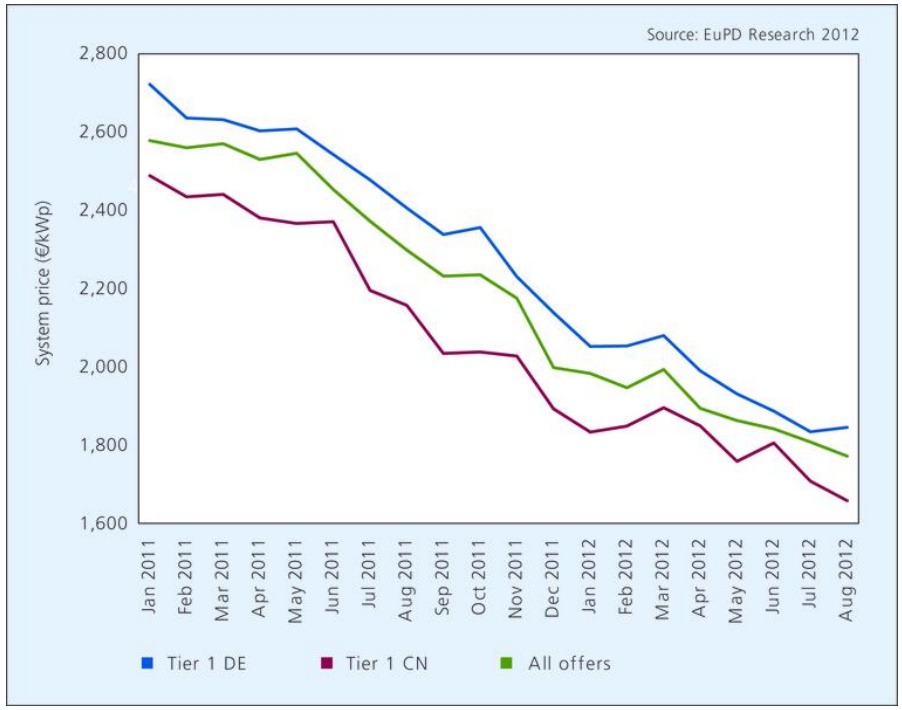
CONTENT

- RES installed capacity and expected future development in Czech Republic
- Power quality issues
- DSO dispatching control of DER - requirements
- Active power control - existing solutions
- Volt/Var control of DER on MV - expected approach
- Volt/Var control of DER on LV - expected approach
- Voltage regulated distribution transformers

RES INSTALLED CAPACITY IN CZECH REPUBLIC

- Total installed capacity in PV in Czech Republic = 2 124 MW
- Total installed capacity in Wind in Czech Republic = 269 MW
- Total installed capacity of all power plants in Czech Republic = 21 000 MW
- Expected rise of PV capacity in near future thanks to decrease of PV technology prices





POWER QUALITY ISSUES – EN 50160 STANDARD

EN 50160 – power quality parameters:

- Voltage = local parameter ⇨ DSO
- Flicker = local parameter ⇨ DSO
- THD = local parameter ⇨ DSO
- Attenuation of ripple control signal = local parameter ⇨ DSO
- Frequency = global parameter ⇨ TSO

DSO should secure power quality for all customers connected to the distribution networks

DSO DISPATCHING CONTROL OF DER

ČEZ Distribuce requirements (DER>100kW):

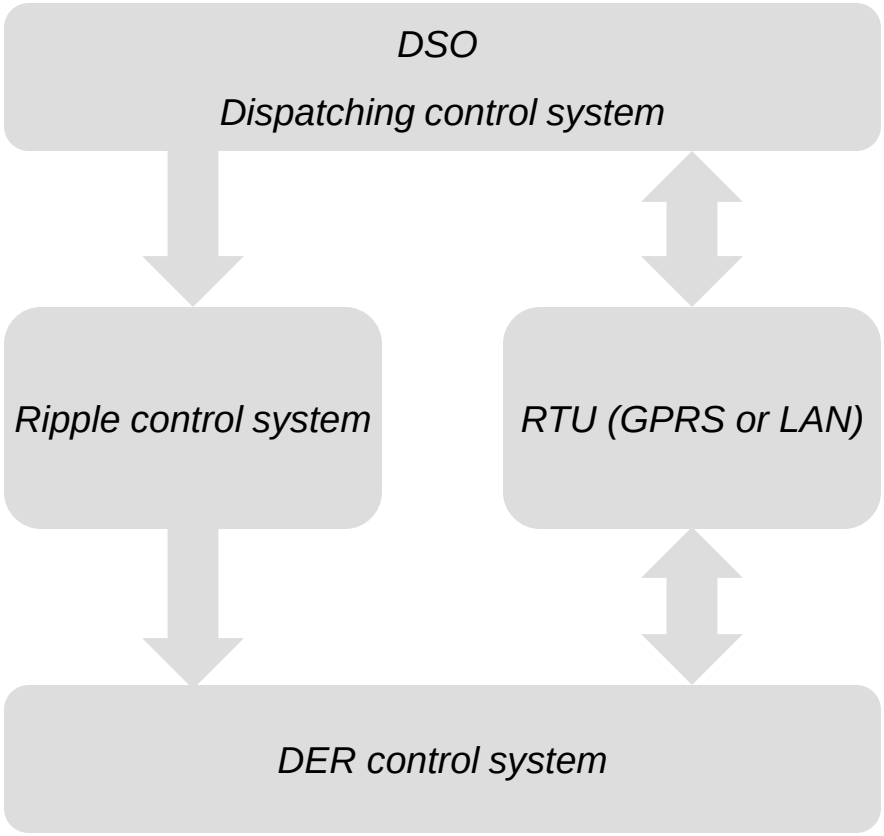
- Active power control of DER: 100%, 60%, 30%, 0%
  - levels of maximum active power production
- Active power control of Biogas: 100%, 75%, 50%, 0%
  - because of technical capabilities
- Reactive power control: Volt/Var control may be required (on HV and MV)

ČEZ Distribuce requirements (30kW<DER<100kW):

- Active power control of DER: 100%, 0%
  - levels of maximum active power production

Active power control would apply only in the case of Emergency – no compensation for DER operators in that case

RTU for dispatching control of DER>100kW – installation on PV (example)



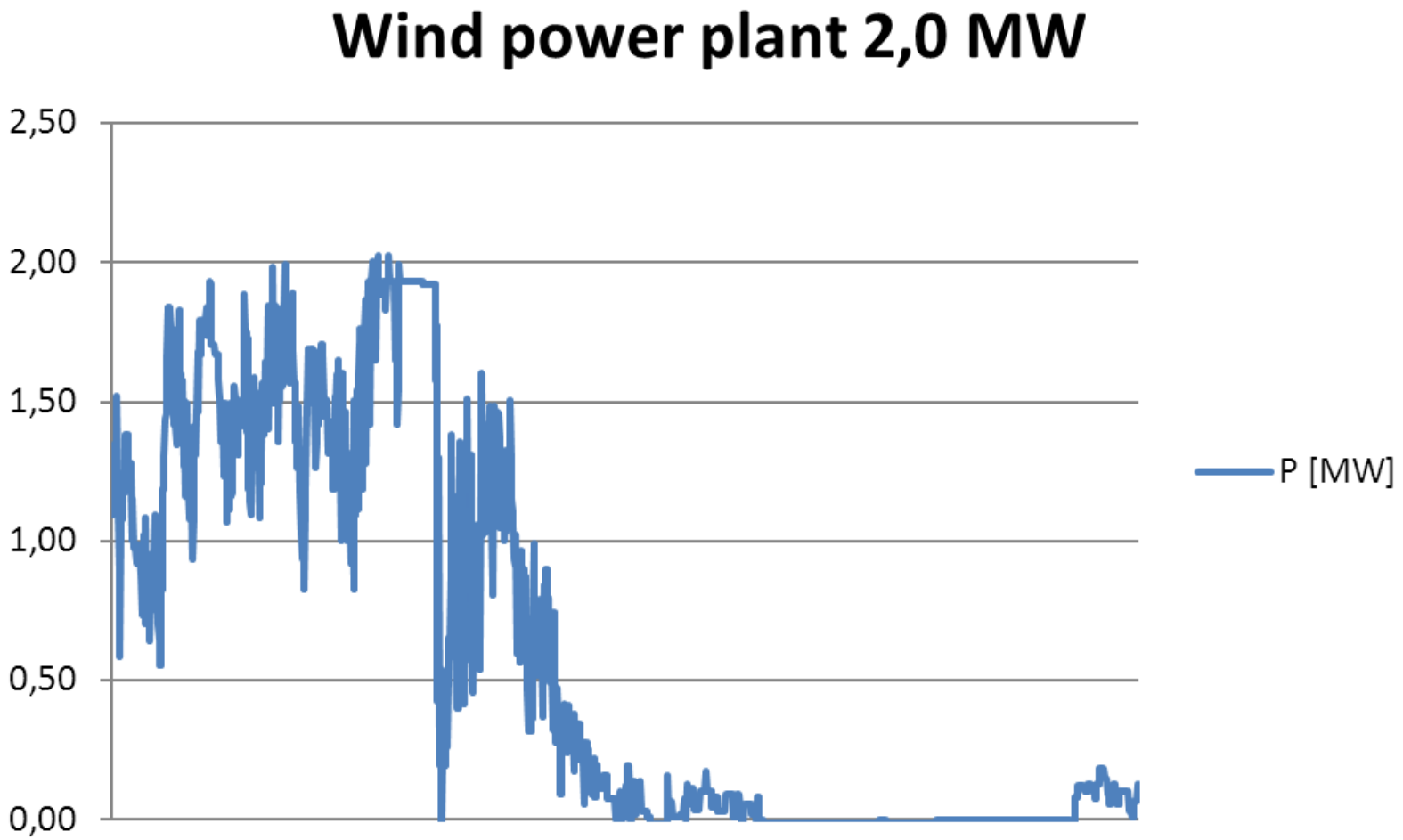
RCS for dispatching control of DER>100kW – system description

Ripple control system transmitter → *Ripple control system couplers* → *Ripple control system receiver* → *DER RTU*

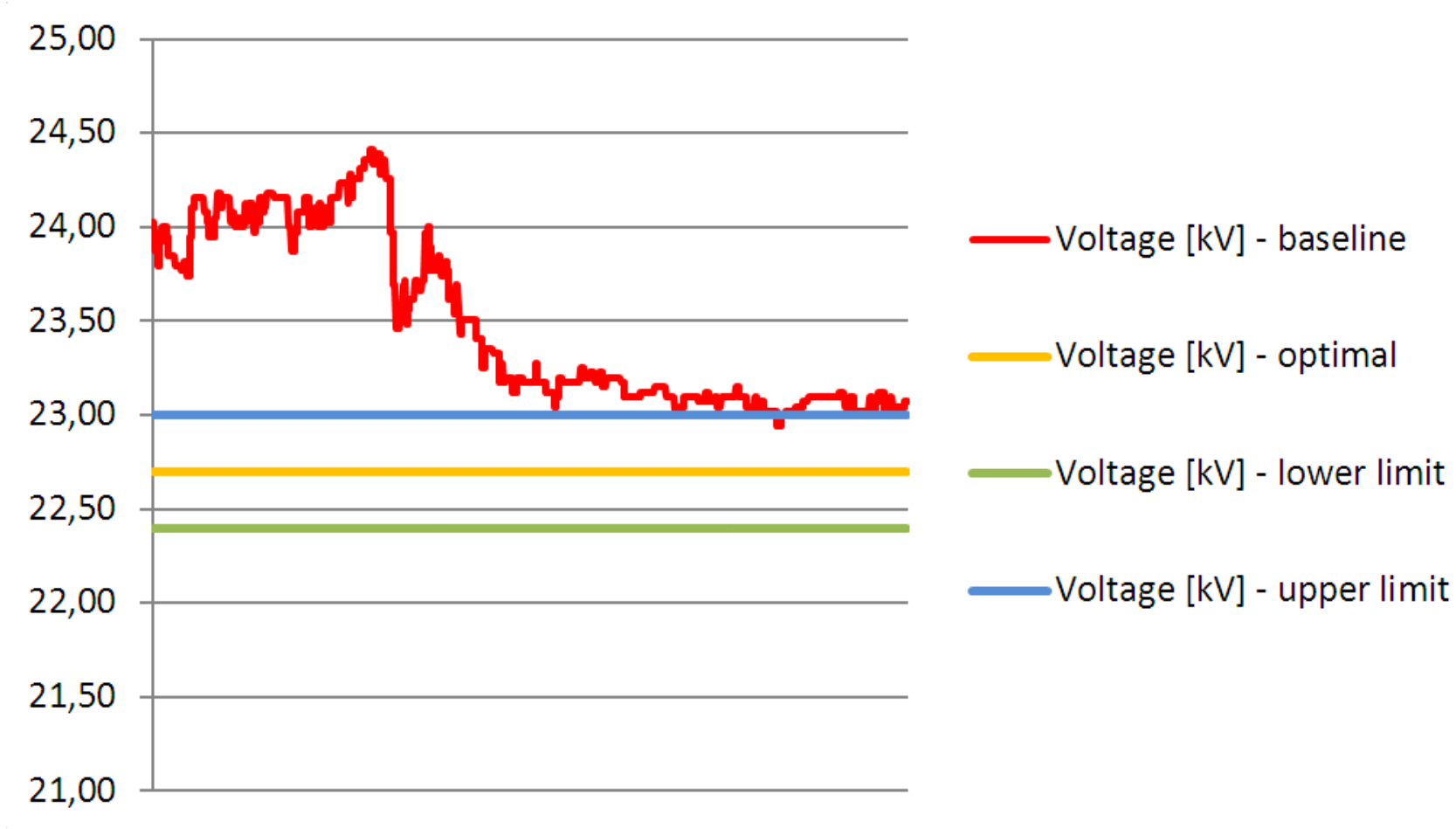
VOLT/VAR CONTROL ON MV – EXPECTED APPROACH

- DER in distribution networks affect voltage levels because of volatile production
- Pilot area – 40 MVA HV/MV transformer with OLTC in HV/MV substation, 26,7 MW in wind power plants (mostly Vestas V90 turbines) and 0,5 MW in solar power plants
- DER in pilot area, especially in case of windy weather cause the increase of voltage level beyond the tolerance given by EN 50160 standard (±10%)
- DER in pilot area also increase voltage out of tolerance defined in the Contract for connection (± 2% on MV)
- According to the study, DER participation in V/Q regulation should stabilize voltage
- High potential for rollout – cost effective solution for voltage stabilization in MV grids

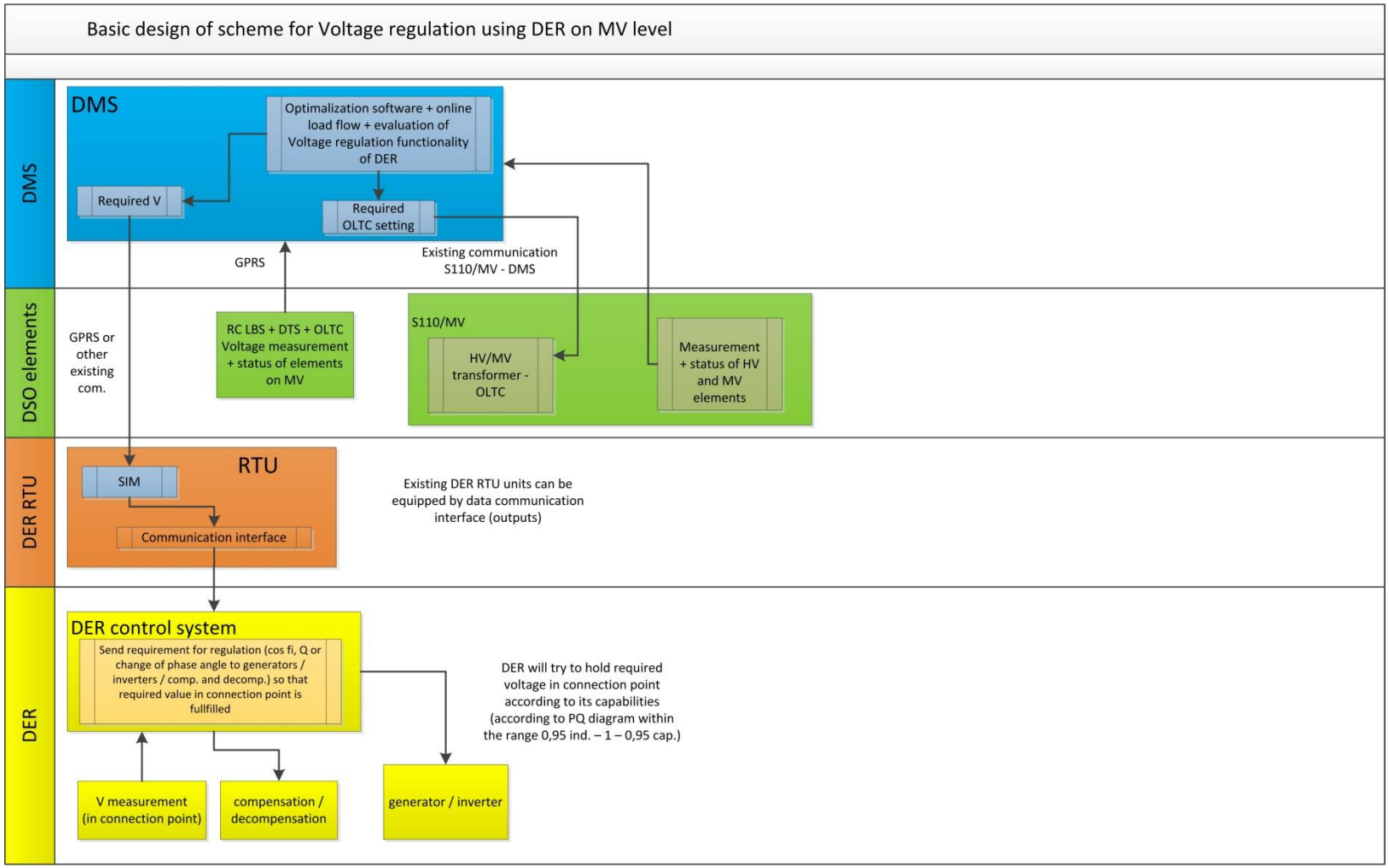
VOLT/VAR CONTROL ON MV – WIND POWER PLANT PRODUCTION EXAMPLE



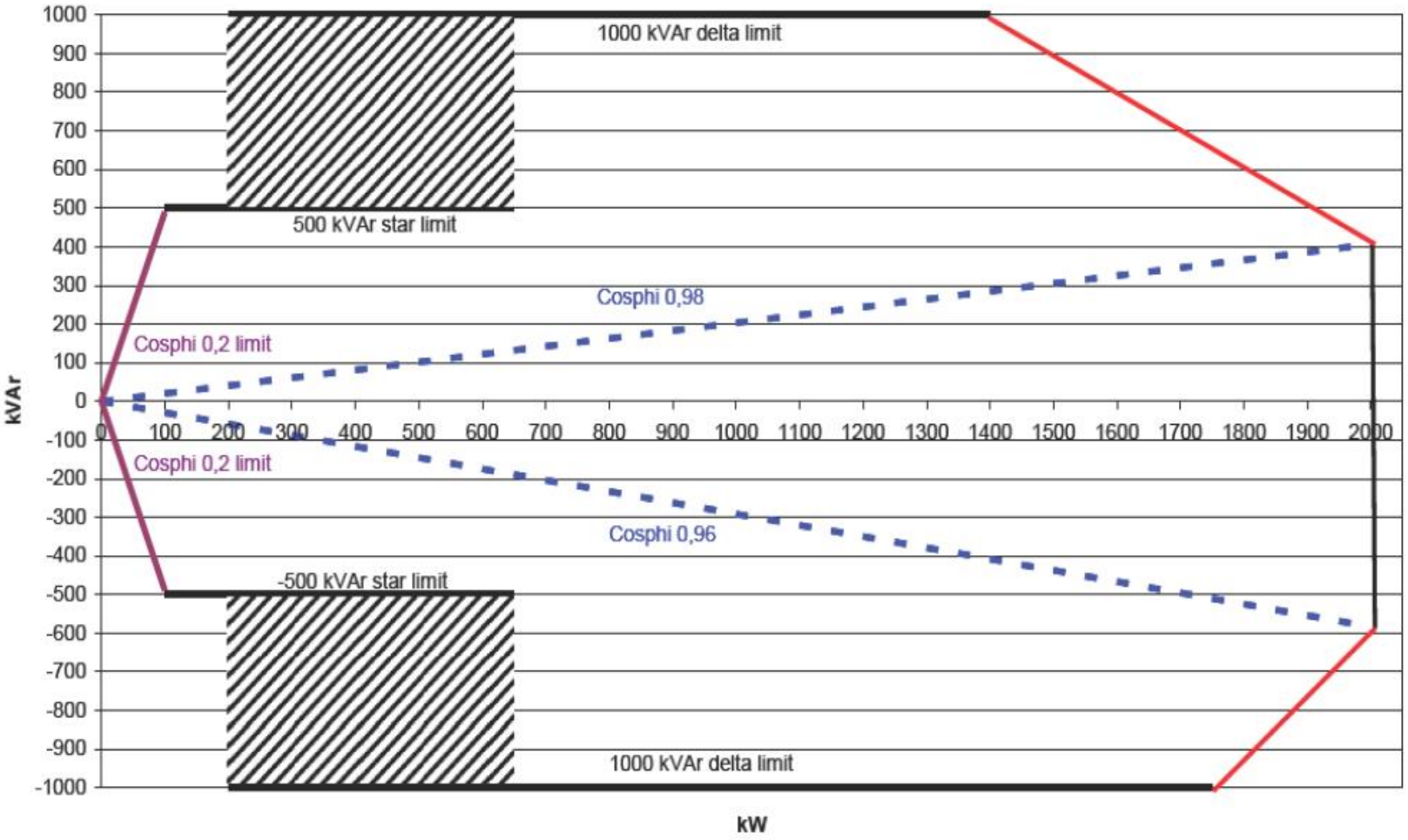
VOLT/VAR CONTROL ON MV – VOLTAGE LEVELS IN DISTRIBUTION NETWORK



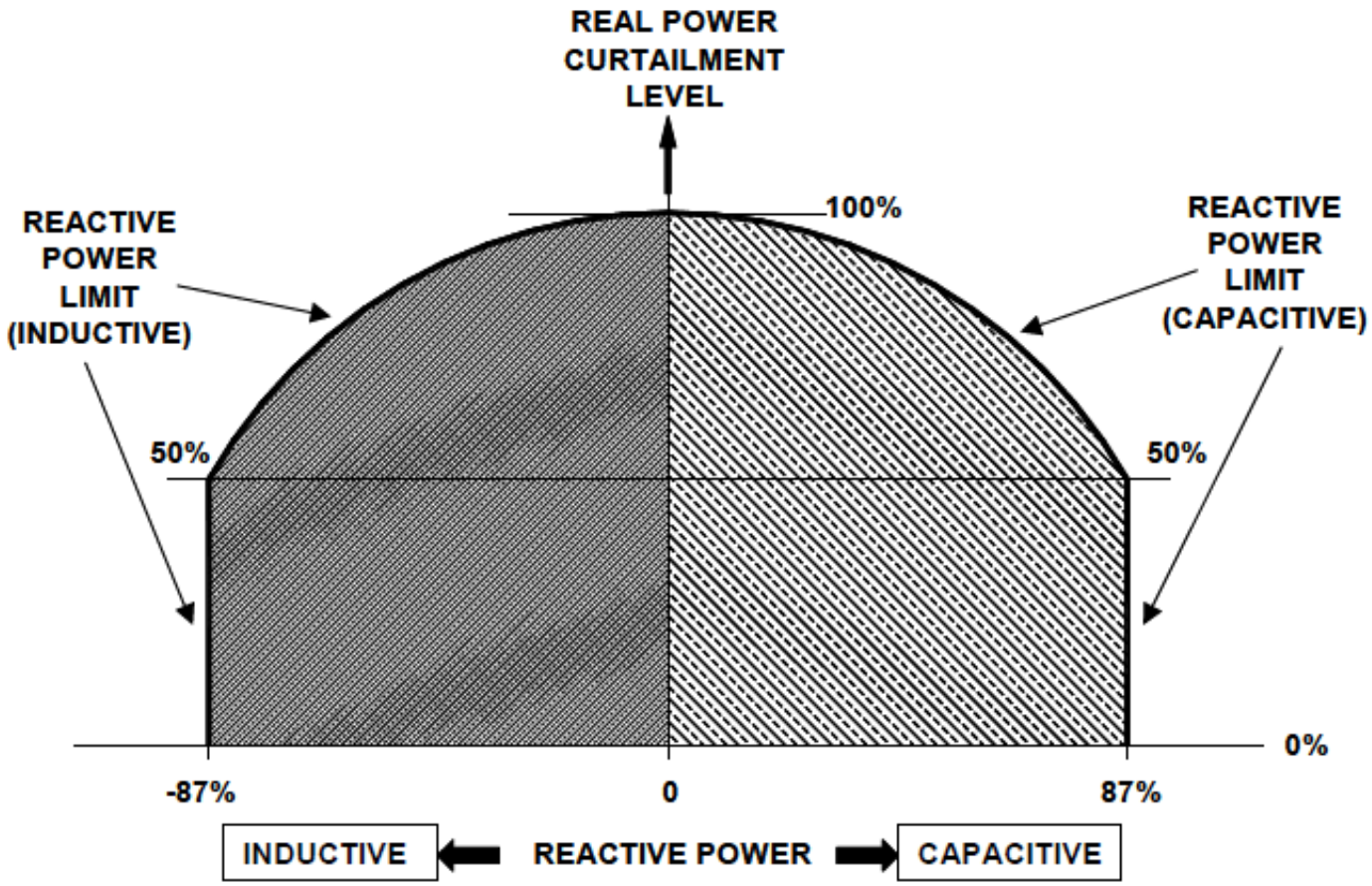
VOLT/VAR CONTROL ON MV – DESIGN OF SCHEME FOR VOLTAGE REGULATION



VOLT/VAR CONTROL ON MV– WIND TURBINE REACTIVE POWER CAPABILITIES



VOLT/VAR CONTROL ON MV - SOLAR INVERTERS REACTIVE POWER CABABILITIES



VOLT/VAR CONTROL ON MV – IMPACT ON STAKEHOLDERS

DSO

- Investment in the completion of the online voltage measurement in pilot area
- Investment in the commissioning and parameterization of software functionalities within existing distribution management system (SCADA)
- No need to construct new interconnections in distribution networks due to higher DER penetration

DER operators

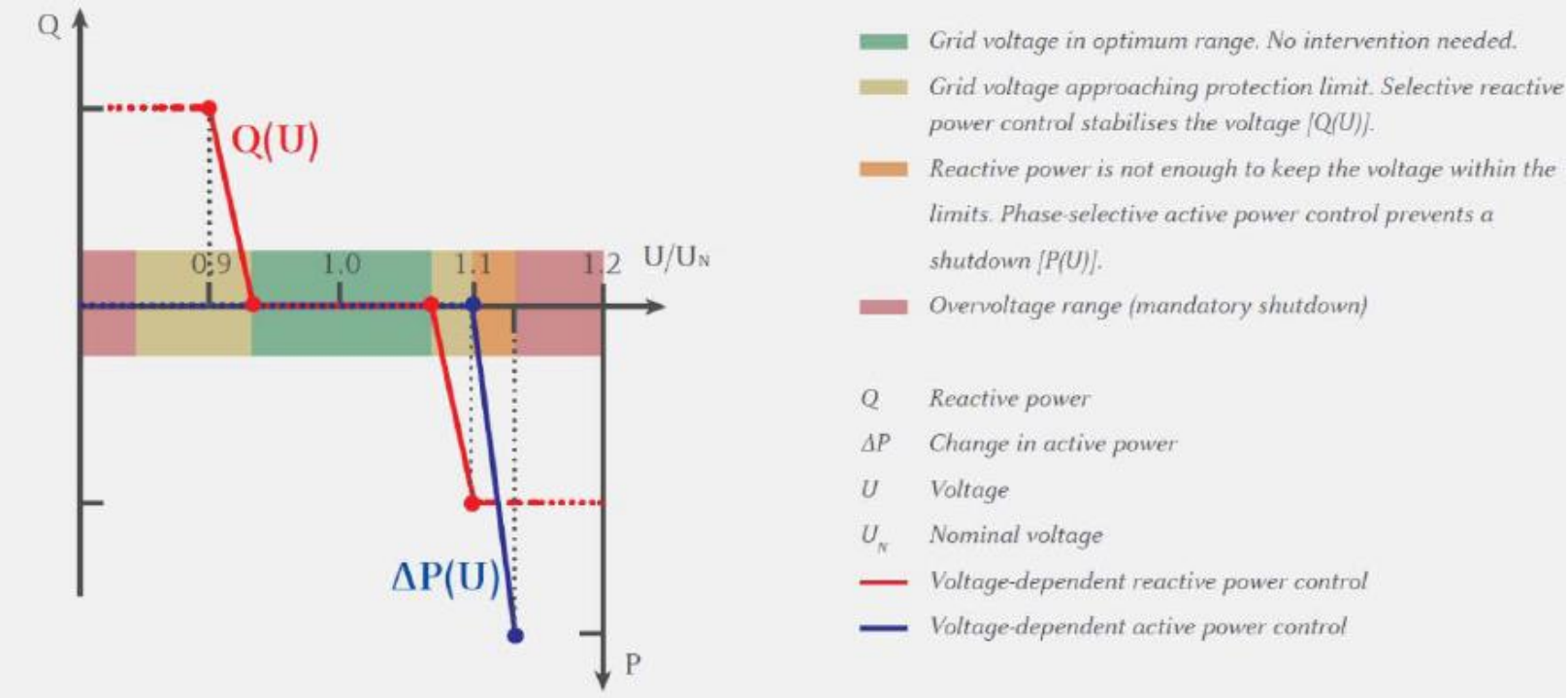
- Investment in the equipment (control system + invertors/generators with reactive power supply capability)
- Parameterization of the control system (algorithms for V/Q regulation)

Customers

- Improved quality of power supply provided by DSO
- Lower pressure to increasing of distribution tariffs (no major DSO investment compared to the interconnections construction)

Functions defined in standard EN 50438 ed.2

- Q(U) characteristics – automatic supply/consumption of Q according to measured V value in the point of connection
- Automatic reduction of active power in the case of overvoltage in the point of connection
- New inverters are already equipped with these functions



VOLT/VAR CONTROL ON LV – IMPACT ON STAKEHOLDERS

DSO

- Change of connection requirements for new DER on LV
- Investment in measurement of voltage profiles on LV
- No need to construct new interconnections in distribution networks due to higher DER penetration

DER operators

- Using inverters with Volt/Var control function for future projects
- Parameterization of the Volt/Var control function in inverters according to DSO requirements

Customers

- Improved quality of power supply provided by DSO
- Lower pressure to increasing of distribution tariffs (no major DSO investment compared to the interconnections construction)

VOLTAGE REGULATED DISTRIBUTION TRANSFORMERS

VRDT

- Automatic tap changing according to voltage levels on MV or LV
- In some cases could be used for solving problems with DER integration
- In some cases could be cheaper to replace existing transformer with VRDT instead of strengthening the distribution network
- Control panel of VRDT could be connected by communication to dispatching control system

THE END

THANK YOU VERY MUCH FOR YOUR ATTENTION

- Contact: stanislav.hes@cezdistribuce.cz