

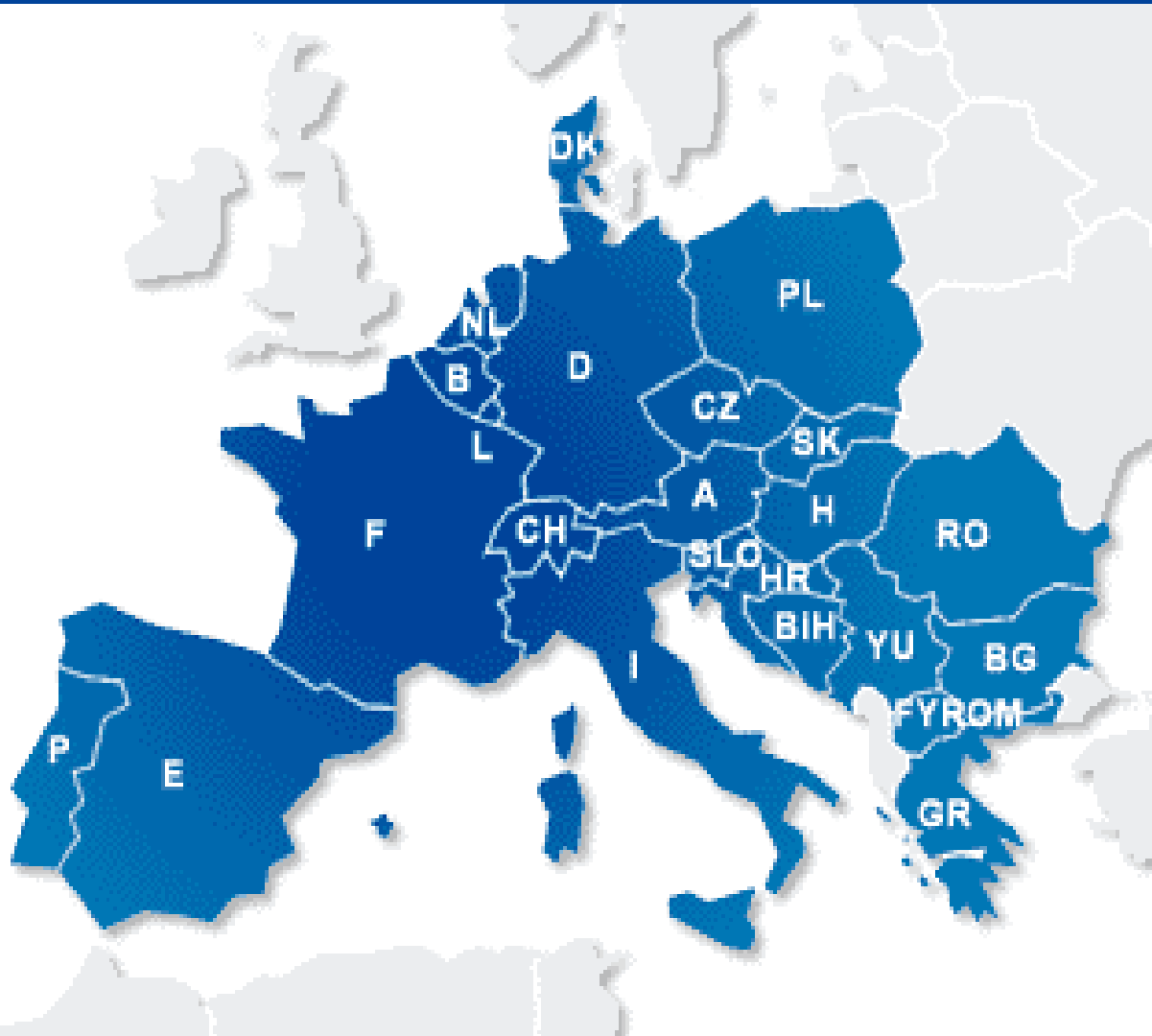
Základné technické pravidlá pre veľké synchrónne prepojené sústavy

Andrej Hanzel

Častá, 26.4.2017



100% dcérska spoločnosť SE, a.s.

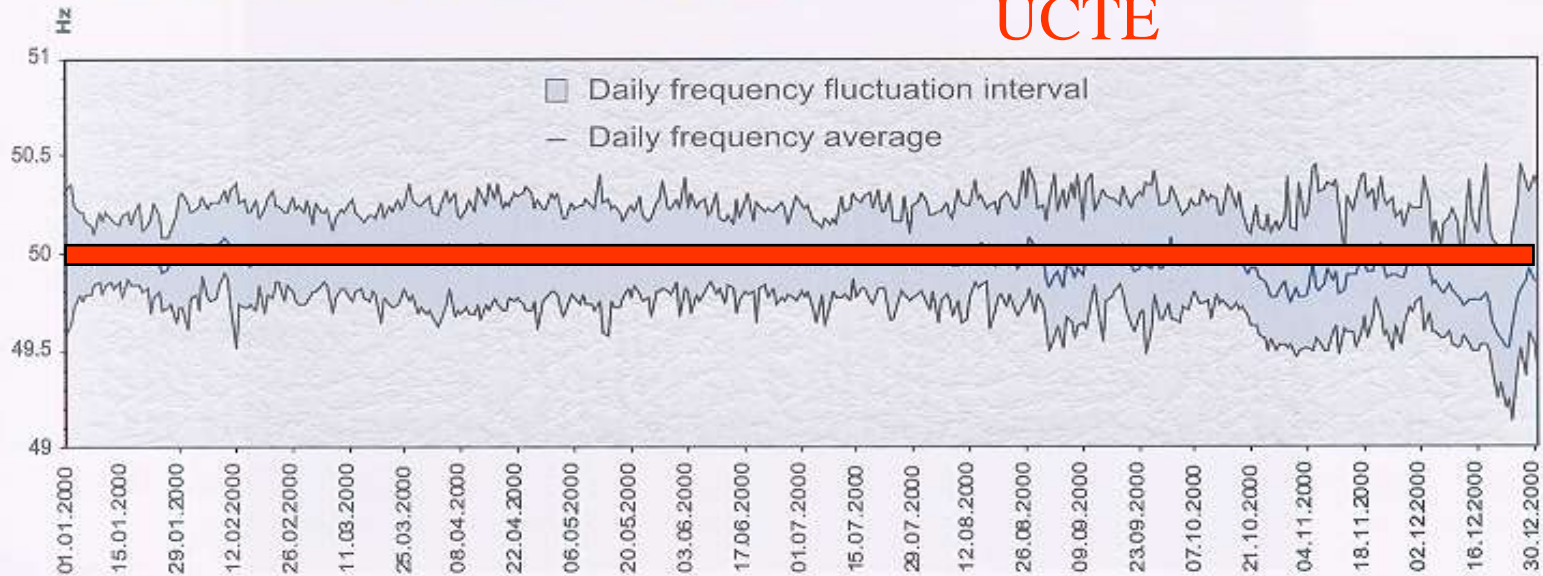


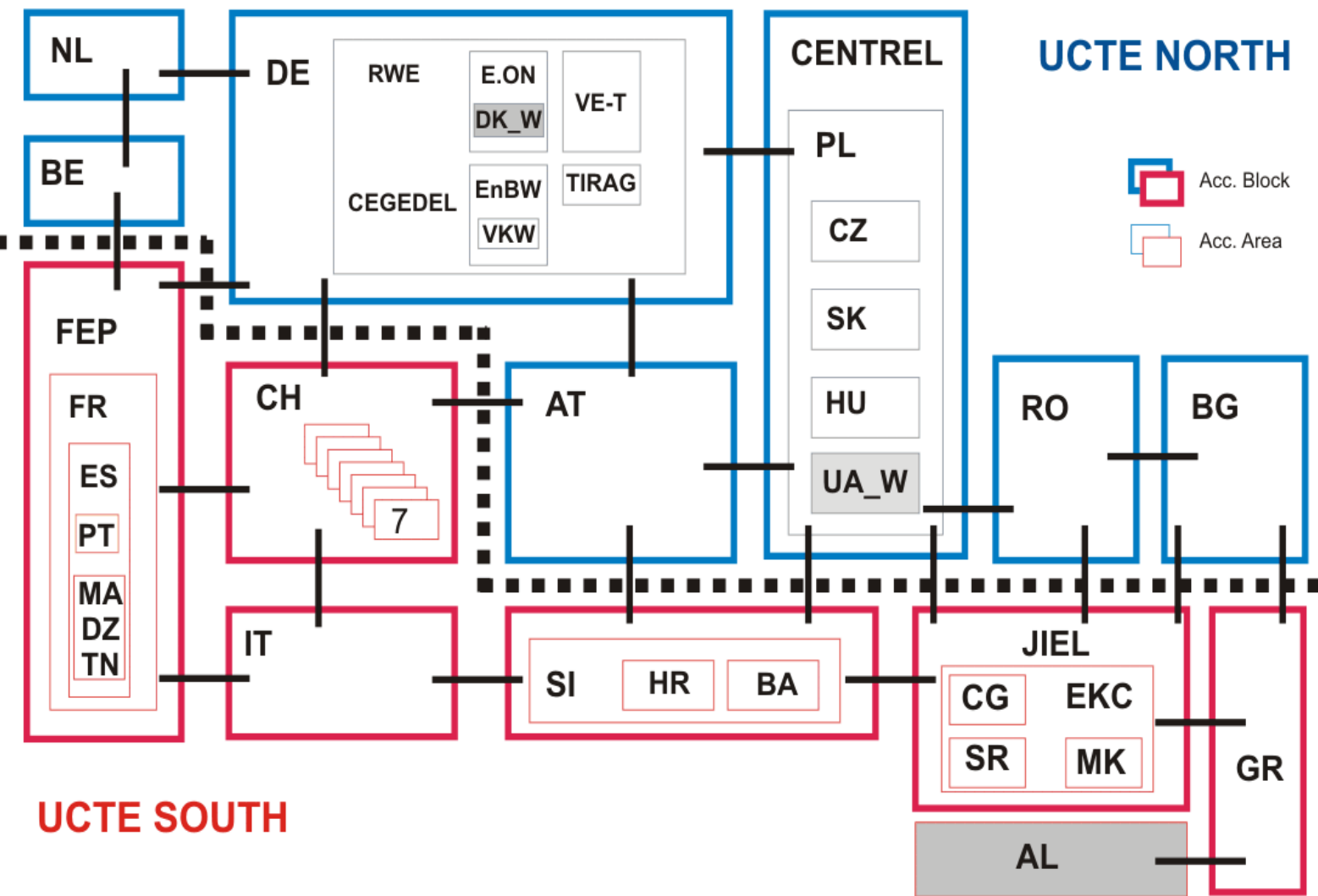
- **The biggest synchronously interconnected grid in the world**
- **450 mil population**
- **50Hz \pm 50mHz**

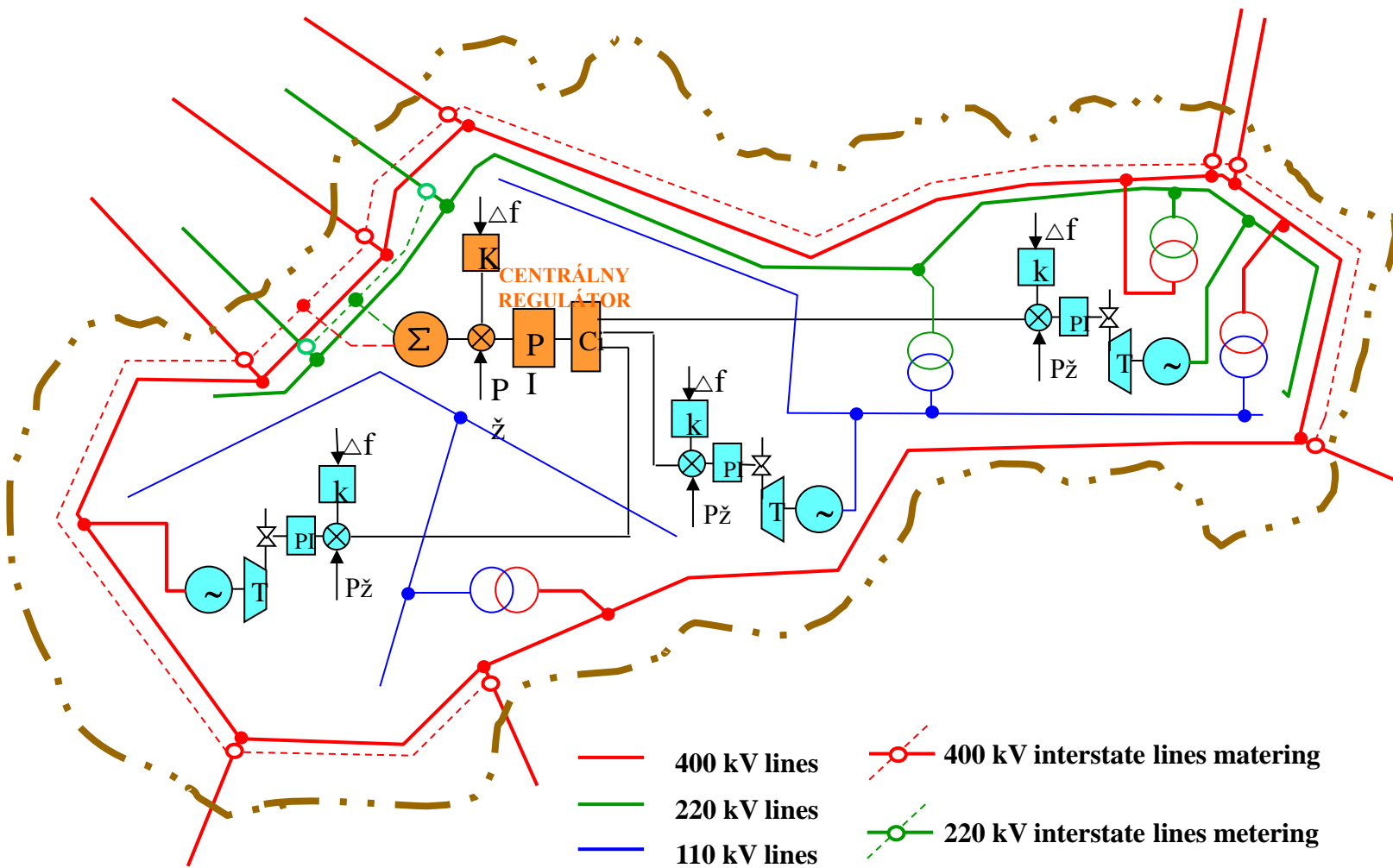
Frequency in Romania, Bulgaria before and now

UCTE

DAILY FREQUENCY VARIATION IN 2000







— 400 kV lines
 — 220 kV lines
 — 110 kV lines

- - - 400 kV interstate lines metering
 - - - 220 kV interstate lines metering

Ancillary services



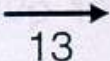
The most important is:

- primary regulation – contribution of particular turbines toward any fault of system when formula „generation = consumption“ is not valid.
- Each regulatory area must provide this type of regulation on base of formula:
$$P_i = c_i * P_c \qquad c_i = E_i / E$$
- $P_c = 3\,000$ MW
- Grid Code of Germany – primary and secondary regulation only 200 MW turbine

Ancillary services cont'd

Transmission grid operator is responsible for operation of regulatory area mainly from point of view:

- Security of supply in particular regulatory area
- International cooperation with other regulatory areas

-  Generation 1000 MW
-  Consumption 1000 MW
-  Percentage share in transit

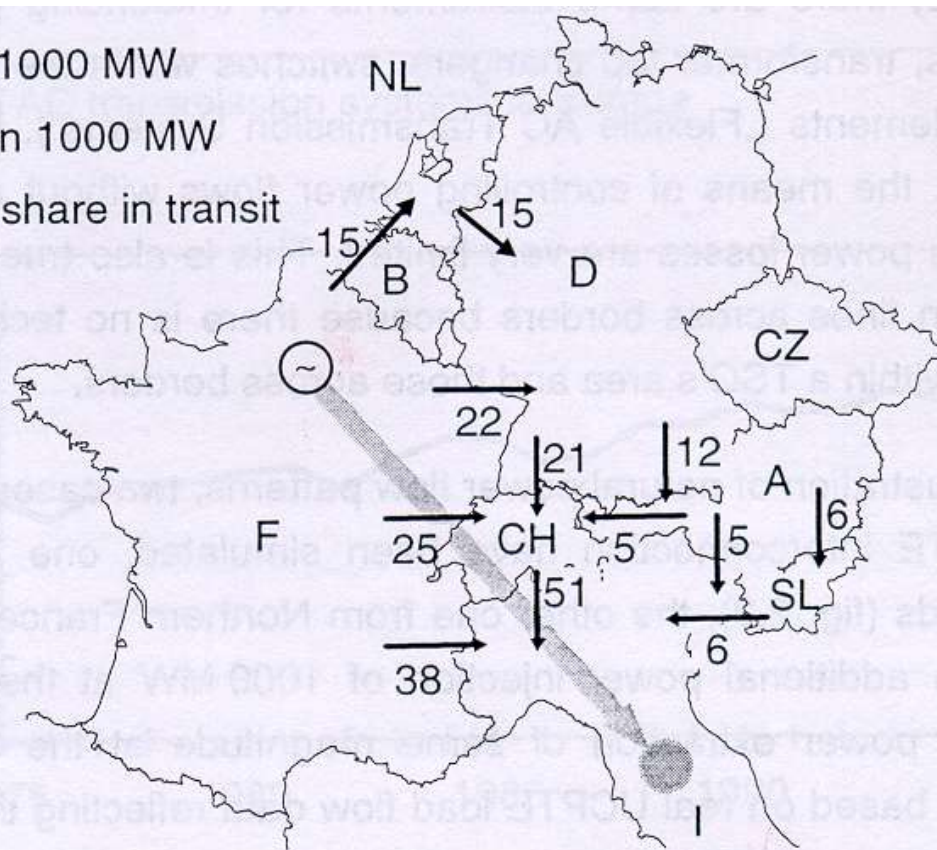
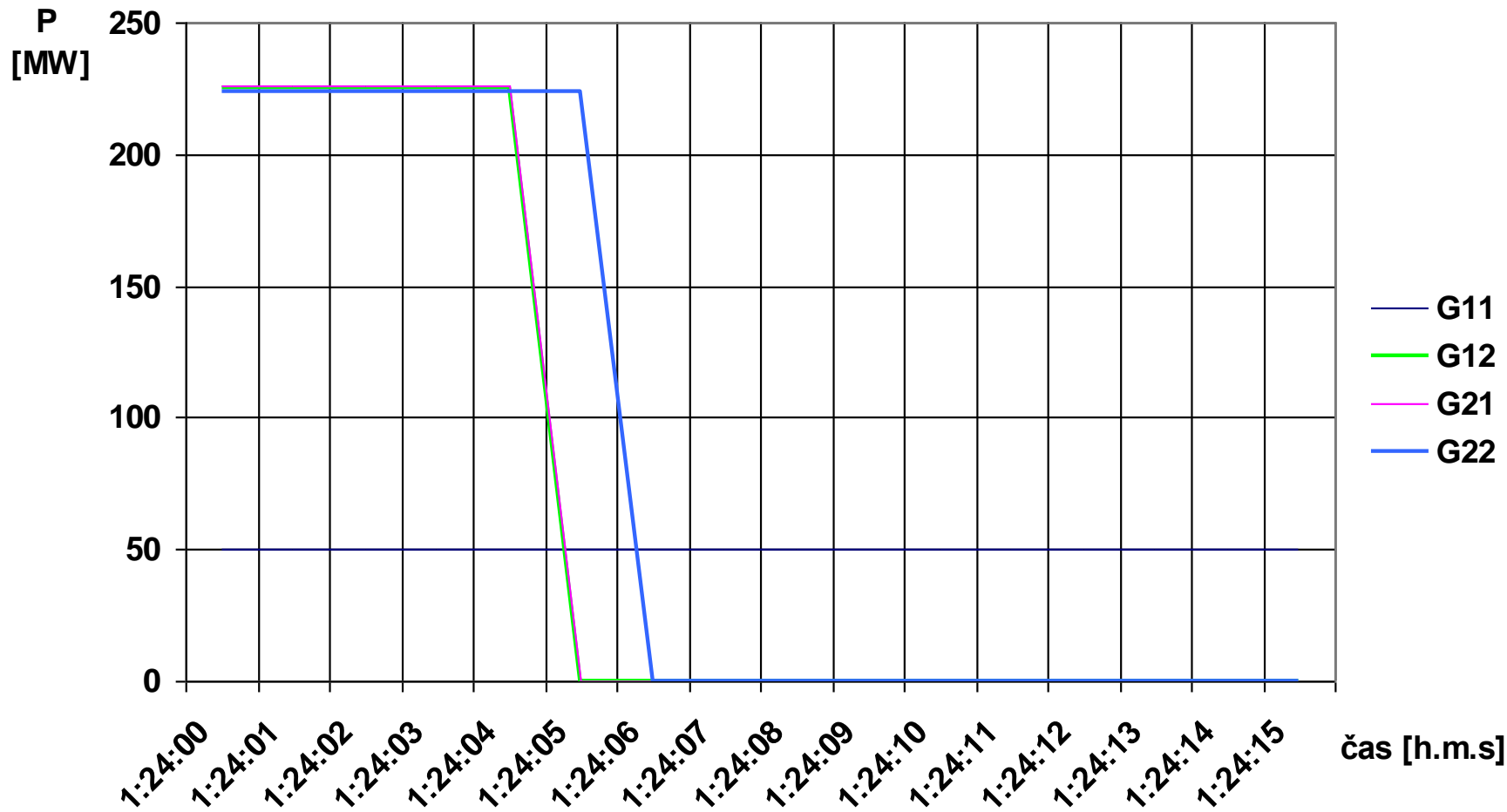
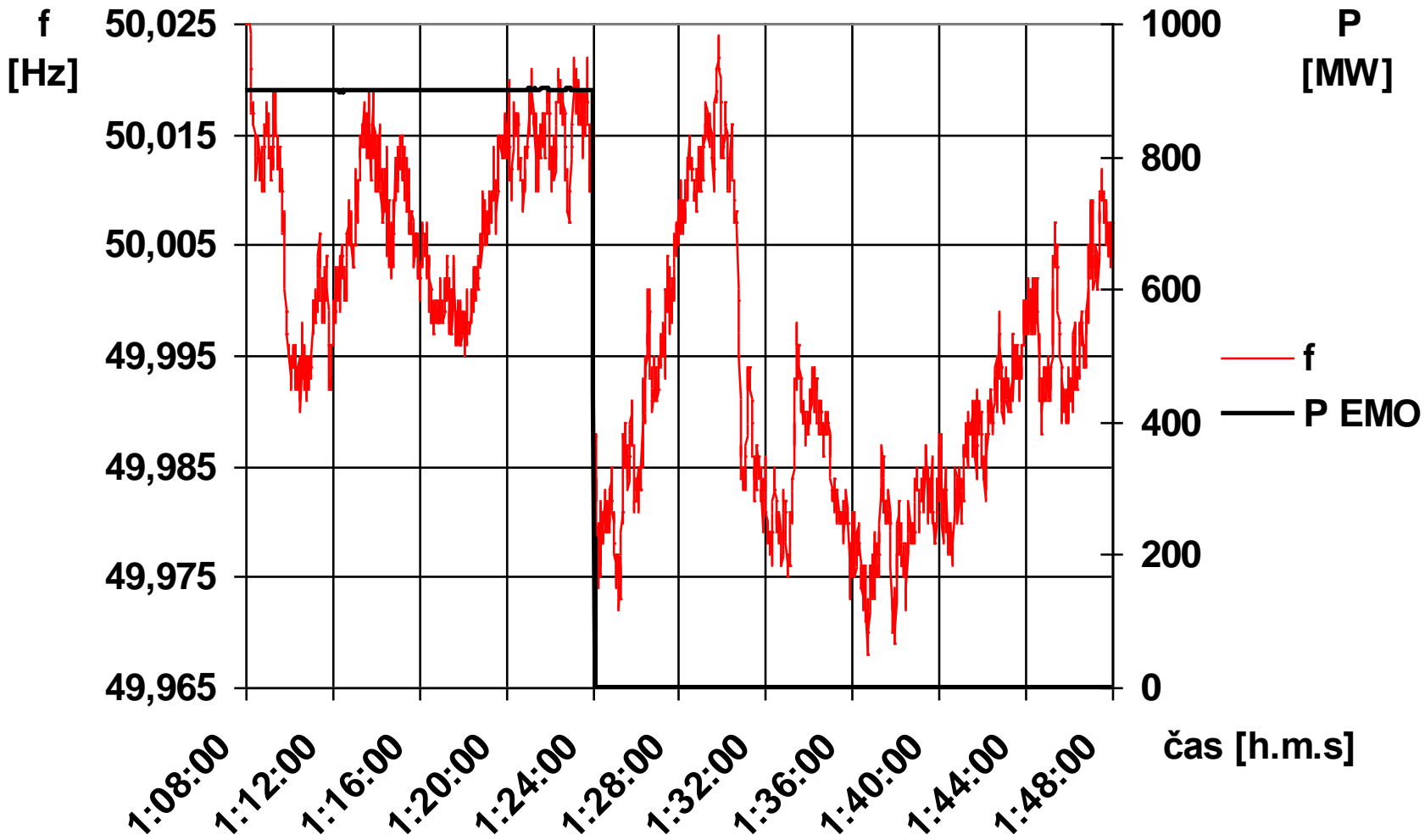
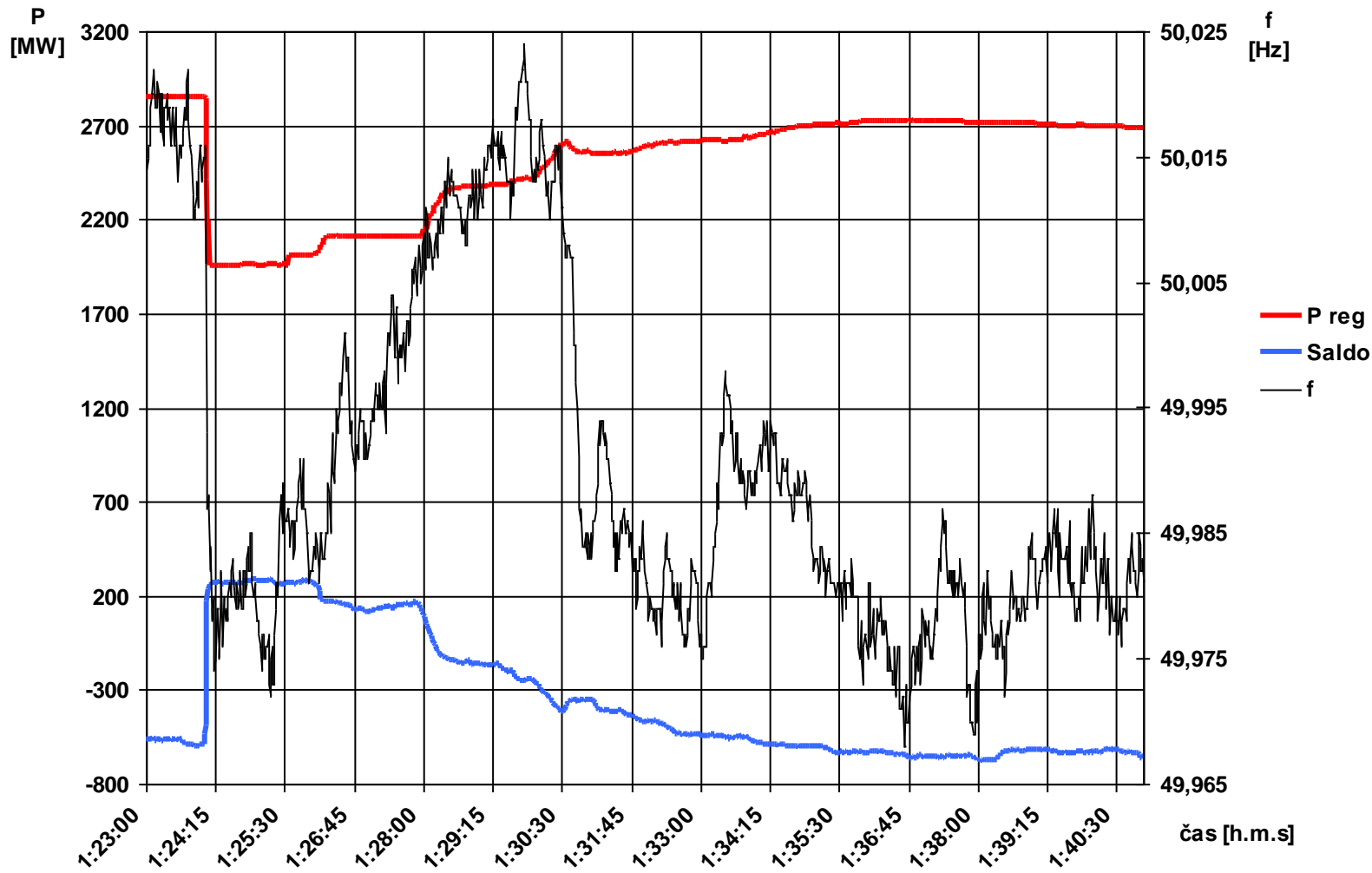
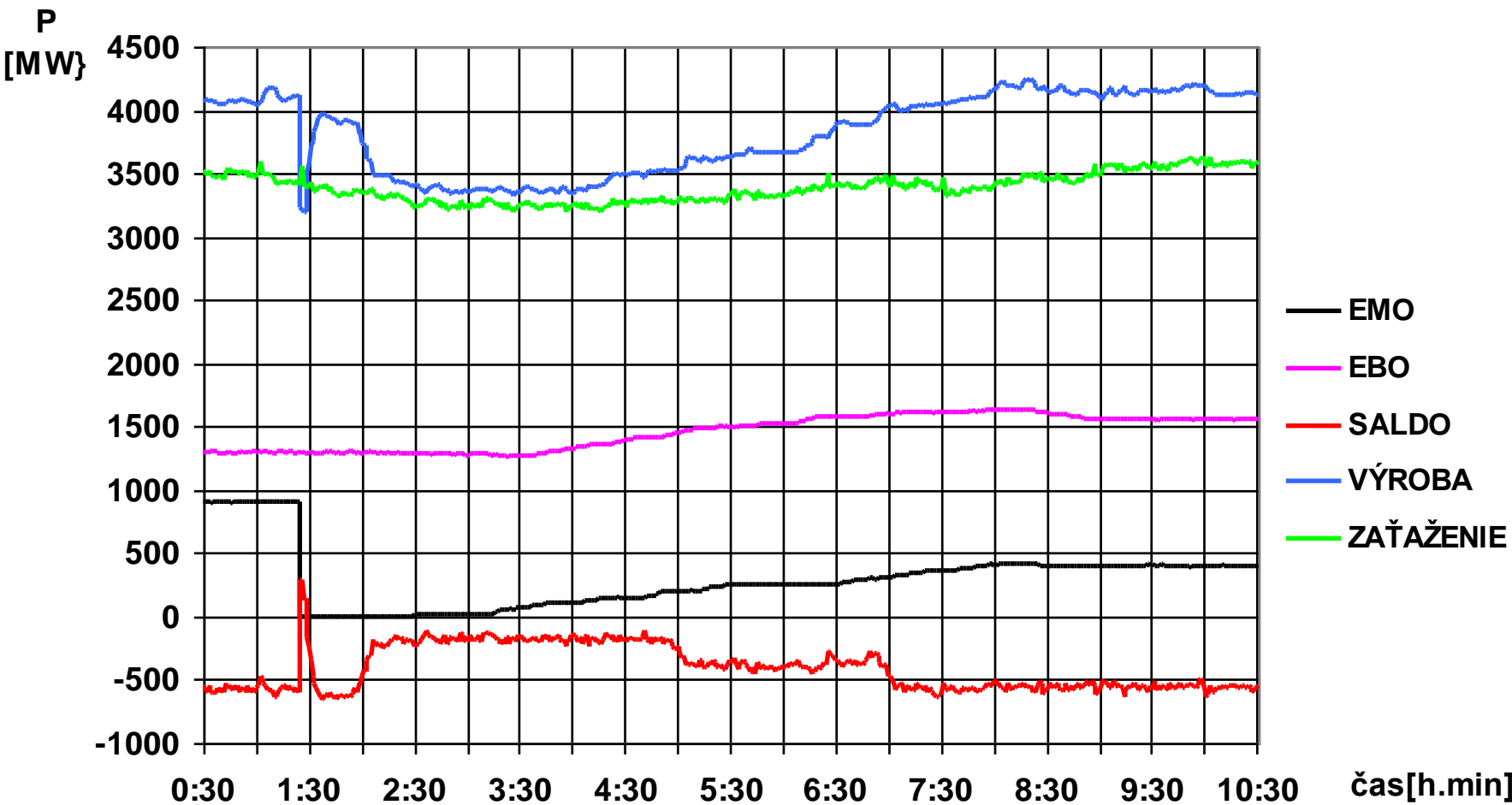


Fig. 2.4: Power flow distribution of a 1000-MW-transport from Northern France to Italy (simulation results; only major flows shown)









440 kV

220kV

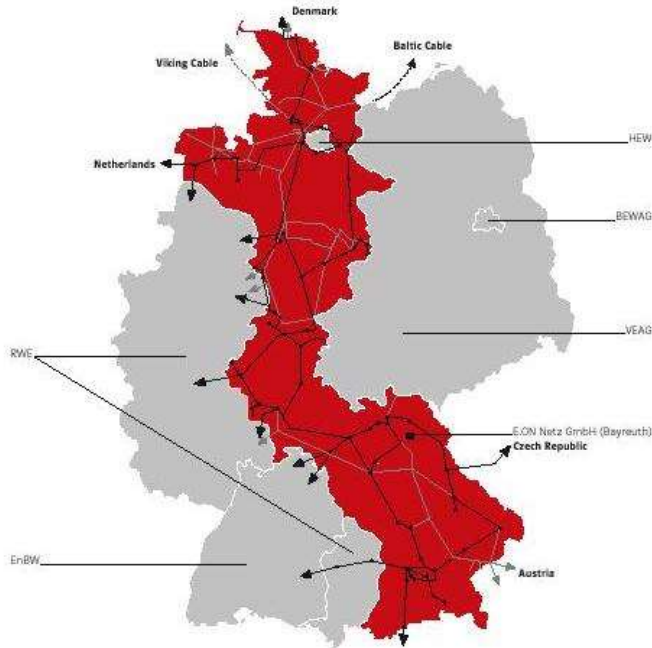
110 kV

22k

V

400/230V

Štandardná
regulačná
oblasť:
- Súčasťou
PS je aj 110
kV linka



- Headquarters
- Substation
- 380-kV
- 220-kV
- HVDC cable
- HVDC (planned)

Grid length			
In kilometers	380 kV	220 kV	110 kV*
E.ON Netz	5,300	5,500	23,800
Germany	28,749	29,753	33,671

*The 110kV is not depicted in the graphic.

- Total grid length: 37,000 km (including 110 kV lines of E.ON Energie's e.d.s.)

Year-end 2000

Holding Company

- E.ON Energie AG
- Corporate strategy, controlling, and services
- Merger & Acquisitions

Conventional Power Plants

- E.ON Kraftwerke GmbH 100%
- Power generation by conventional power plants
- District heating, waste incineration
- Generation projects

Nuclear Power Plants

- E.ON Kernkraft GmbH 100%
- Power generation by nuclear power plants

Hydroelectric Power Plants

- E.ON Wasserkraft GmbH 100%
- Power generation by hydroelectric plants

Grids

- E.ON Netz GmbH 100%
- Power transmission across high-voltage grids (110kV – 380kV)
- Load distribution

Regional Distributors

- 12 regional distributors 25% to 98%
- Distribution and supply of electricity, natural gas and water
- Energy consulting

Municipal and Regional Shareholdings

- Thüga AG 57.35%
- ContiGas Deutsche Energie AG 98.75%
- Shareholdings in municipal and regional distributors (mainly: electricity, natural gas, and water)

*Only includes direct shareholdings prior to the merger to form E.ON Bayern.

**Here call for the Thüga-ContiGas merger to be effective retroactively as of January 1, 2001.

†Merger planned.

‡As of begin 2001; 80.6%

Other Shareholdings

- E.ON Fernwärme GmbH 100%
- E.ON Immobilien GmbH 100%
- E.ON Facility Management GmbH 100%
- PfE GmbH (Prüfungsgesellschaft für Energieversorgungsgesellschaften) 92.9%
- Synergis GmbH 49%*
- Gedos GmbH 100%*

Trading

- E.ON Trading GmbH 100%
- Optimization of energy procurement
- Proprietary trading
- Risk management

Sales

- E.ON Vertrieb GmbH 100%
- Electricity sales and services
- Key account management

Integrated Water Utility

- E.ON Aqua GmbH 100%
- Geislerwasser AG 52.4%†
- Regional water procurement and supply
- Wastewater treatment
- Natural gas supply

International Shareholdings

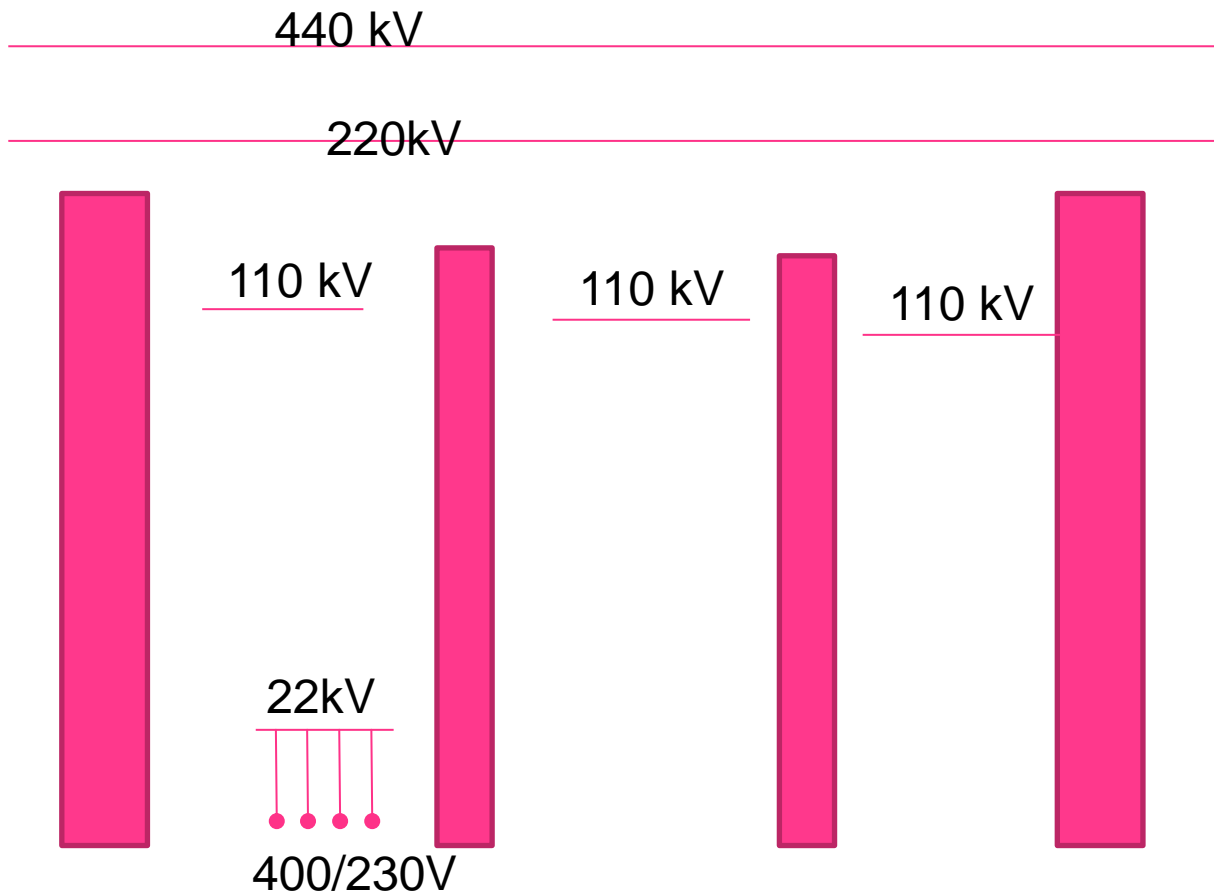
- E.ON Benelux 100%
- E.ON Bohemia 100%
- E.ON Hungary 100%
- E.ON Italia 100%
- E.ON Polska 100%
- E.ON Scandinavia 100%

Consulting/Engineering Services

- E.ON Engineering GmbH 100%
- Intra company and third-party energy planning and consulting
- Marketing of expertise in conventional power generation

Regulačná
oblasť v
Nemecku

The transmission system supplies electricity to substations in individual service areas. Transmission lines transmit electricity from the generation source or substation to distribution substations. Transmission voltages at National Grid vary from 69 kV to 345 kV. Transmission voltages can also be converted to lower subtransmission voltages, typically 15 kV to 69 kV, to supply distribution substations and/or provide electricity to large industrial customers.



Regulačná oblasť
Slovensko

Dni a hodina maxima 2015

Kto	Kol'ko (MW)	Kedy	Hod
ZSE	1 471	9.12.2015	16:15
SSE	1 084	7.1.2015	18:00
VSE	1 471	9.12.2015	16:15

Slovensko 4 146 MW 25.11.2015; 17:00 hod

- UCTE verzus UCPTÉ - vertikálna integrácia v krajinách od rieky Morava na Západ
- HDO – regulácia s vysokou pridanou hodnotou pre sústavu
- Z prevádzkového poriadku PDS
 - Požiadavky dodávateľa elektriny na prepínanie tarify (NT a VT) elektromera prostredníctvom HDO, pre skupiny odberateľov elektriny (v rámci bilančnej skupiny) v časoch a podmienkach odlišných od štandardu Prevádzkovateľa, budú riešené a poskytnuté na základe zmluvy.

Konzekvencie

- Vyššia potreba regulačného výkonu
- G – komponent pre výrobu – deklasovanie výrobcov
- Vyššie straty v prenosovej sústave
- **Horšie dôsledky na životné prostredie.**

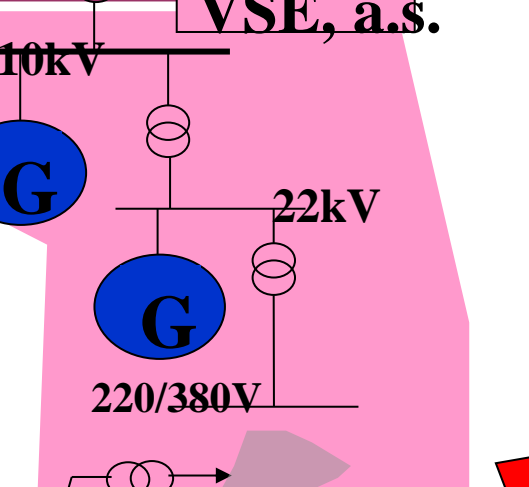
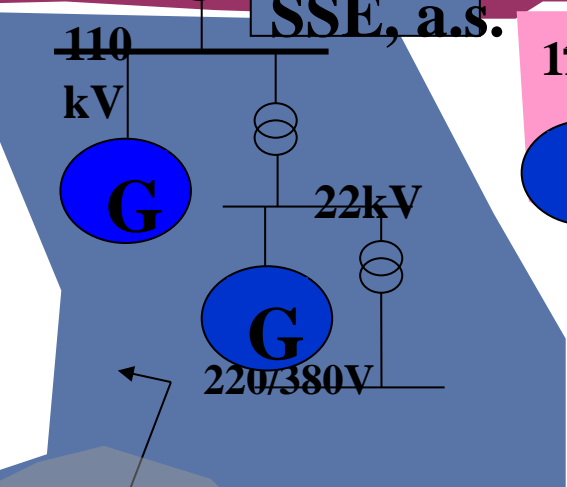
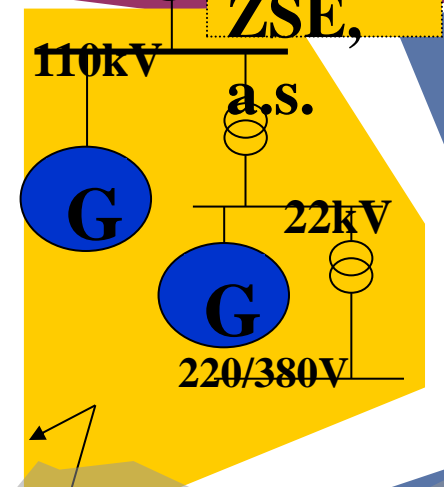
2000



2002



Česko Poľsko Maďarsko Čierny Váh, EVO 2, časť EGA, časť EVO1

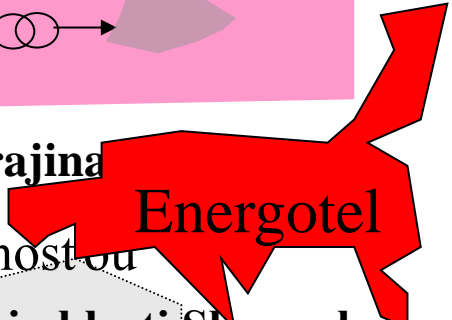


Česko 100kV

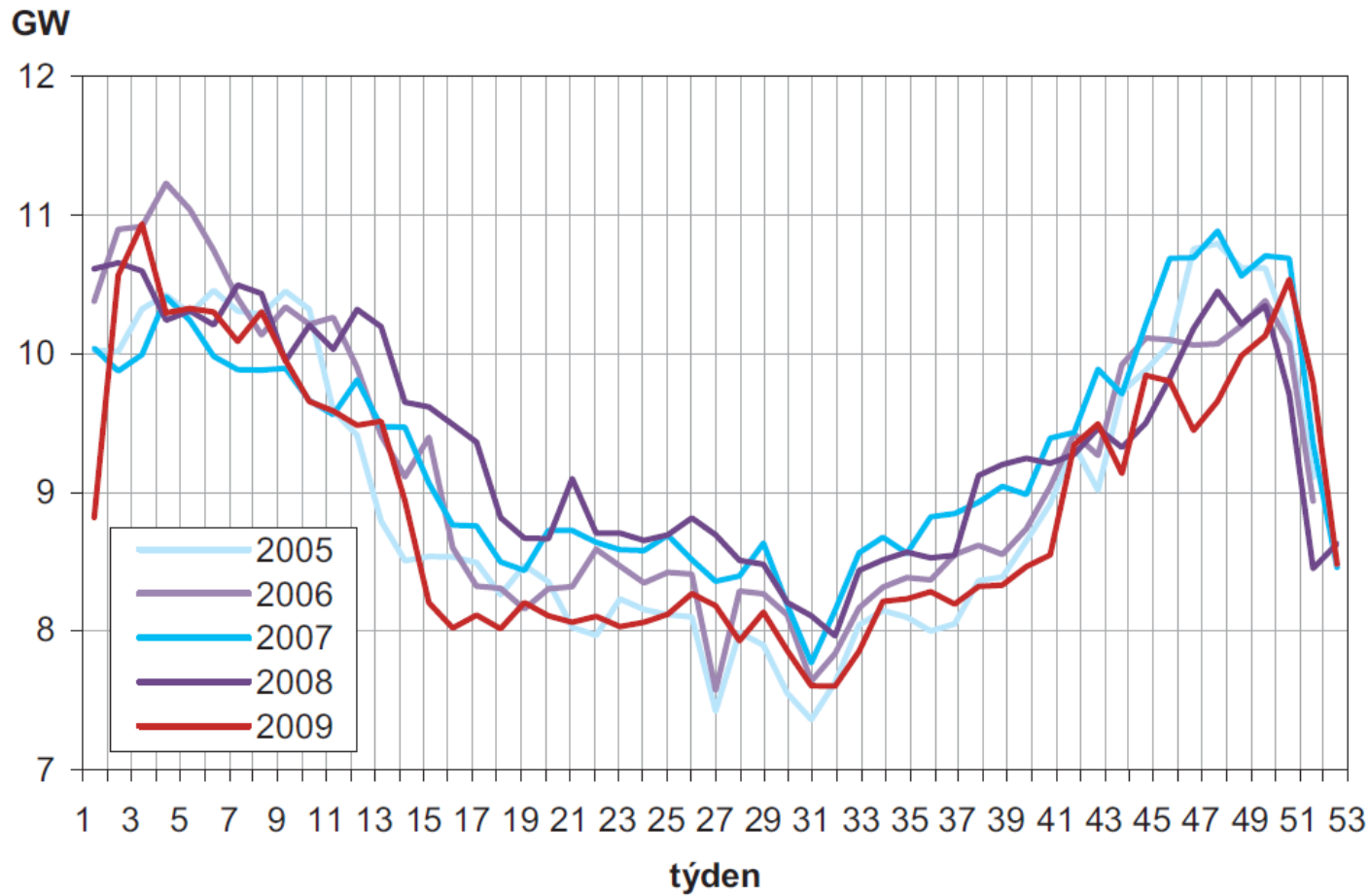
Česko 110kV

Ukrajina

G Generátory SE, a.s., s regulačnou schopnosťou



Ostrovná prevádzka narušujúca celistvosť Regulačnej oblasti Slovensko



Kultúrne a komunikačné bariéry

- Náklady na modernizáciu súvisia s technickou úrovňou z minulosti a porovnanie s okamžitými nákladmi v inej krajine je iba veľmi orientačné
- Politici predpokladajú, že cena elektriny pre zákazníkov je dôležitejšia ako disponibilita a benefit, ktorý vyplýva z modernizácie

Otvorené otázky

- Elektrina je služba a nie tovar
- Služba má iné ciele ako iba tvorba zisku, hoci ani pri službe ekonomika nemôže ísť stranou
- Bezpečnosť v dodávke elektriny musí byť prvou prioritou – cena elektriny v prípade nedostatku nehrá úlohu
- MW verzus MWh
- Rozhodnutia v energetike sa ukážu o 5-10 rokov
- Aplikácia štandardných ekonomických mechanizmov na elektroenergetiku nevedie k dobrým záverom.

Záver

- Snaha liberalizovať elektrický trh trvá od roku 2002. Dnes EU volá aspoň po regionálnych trhoch. **Je vôbec možná liberalizácia?**
- S prenosovou sústavou na Slovensku treba urobiť poriadok. V súčasných majetkových pomeroch to nebude také jednoduché. Je to veľmi silná politická úloha, ktorú **by mohli naštartovať nepolitické analýzy akademickej obce.**

Ďakujem za Vašu pozornosť