



State of UCTE Studies on the Interconnection between the UCTE System and CIS & Baltic States

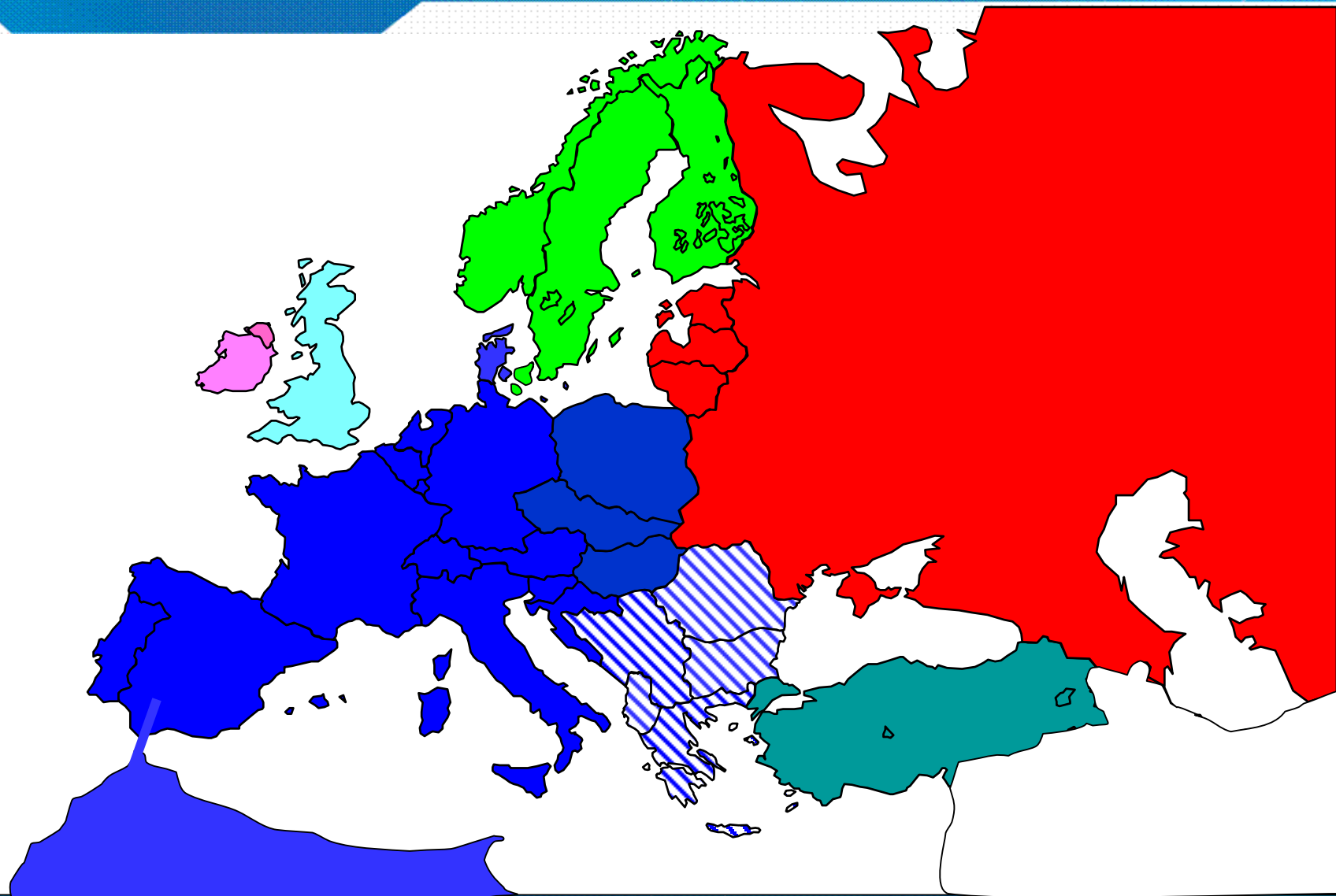
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The synchronous area in 2002



	UCTE	IPS/UPS
Population	400 M	280 M
Capacity	530 GW	315 GW
Output	2100 TWh	1205 TWh
Peak	350 GW	180 GW

General position of UCTE

- **UCTE endeavours the development of interconnection between the UCTE and UPS/IPS system.**
- **UCTE is working on all technical and organizational aspects in order to achieve swift progress in parallel with the trade and environmental issues, which are closely linked.**

General position of UCTE

- **With respect to:**

- **the clear preference for fully synchronous expressed by UPS/IPS**
- **the higher technical complexity in case of synchronous connection**
- **the organizational complexity (involvement of TSOs and generators in case of synchronous)**

the ongoing UCTE study effort is devoted to investigating a synchronous connection scenario.

- **However, UCTE recalls that an integrated electricity market may cover either a fully synchronous area or multiple synchronous areas, connected via HVDC or AC/DC convertors.**

UCTE Action levels

- **Technical studies**

To study in various steps the pre-feasibility and the feasibility of synchronous interconnection from technical viewpoint.

- **Organizational measures**

To agree on TSO coordination framework regarding system operation, grid access rules and capacity allocation where necessary as underpinnings for guaranteeing the technical requirements.

- **Legal – contractual framework**

To reach legally binding commitments with involved operators, such as multilateral cooperation agreement with TSOs, inter-area agreement or legal rules (e.g. Grid Codes for system reserves) for involved generation companies.

- **Technical answers will also need an appropriate organization and binding commitments.**

Pre-feasibility study

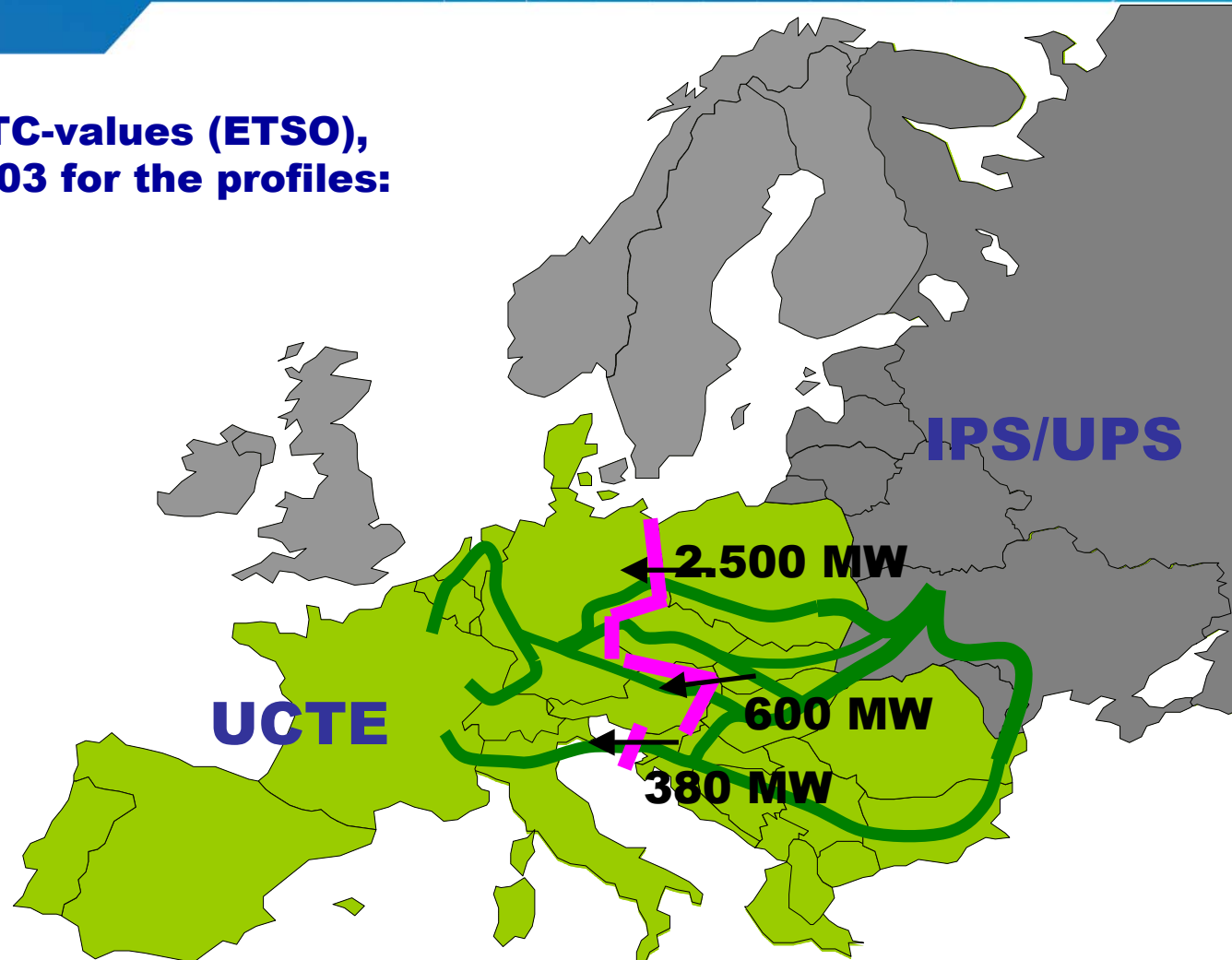
For chosen scenarios, the load flow analysis has given:

- the distribution of power flows**
- the identification of the main transit corridors**
- the identification of the critical areas**
- an evaluation of a range for the maximum exchange capacity**
- a list of items to be studied in the feasibility study.**

Pre-feasibility study: conclusions

Main transit corridors vs. existing bottlenecks

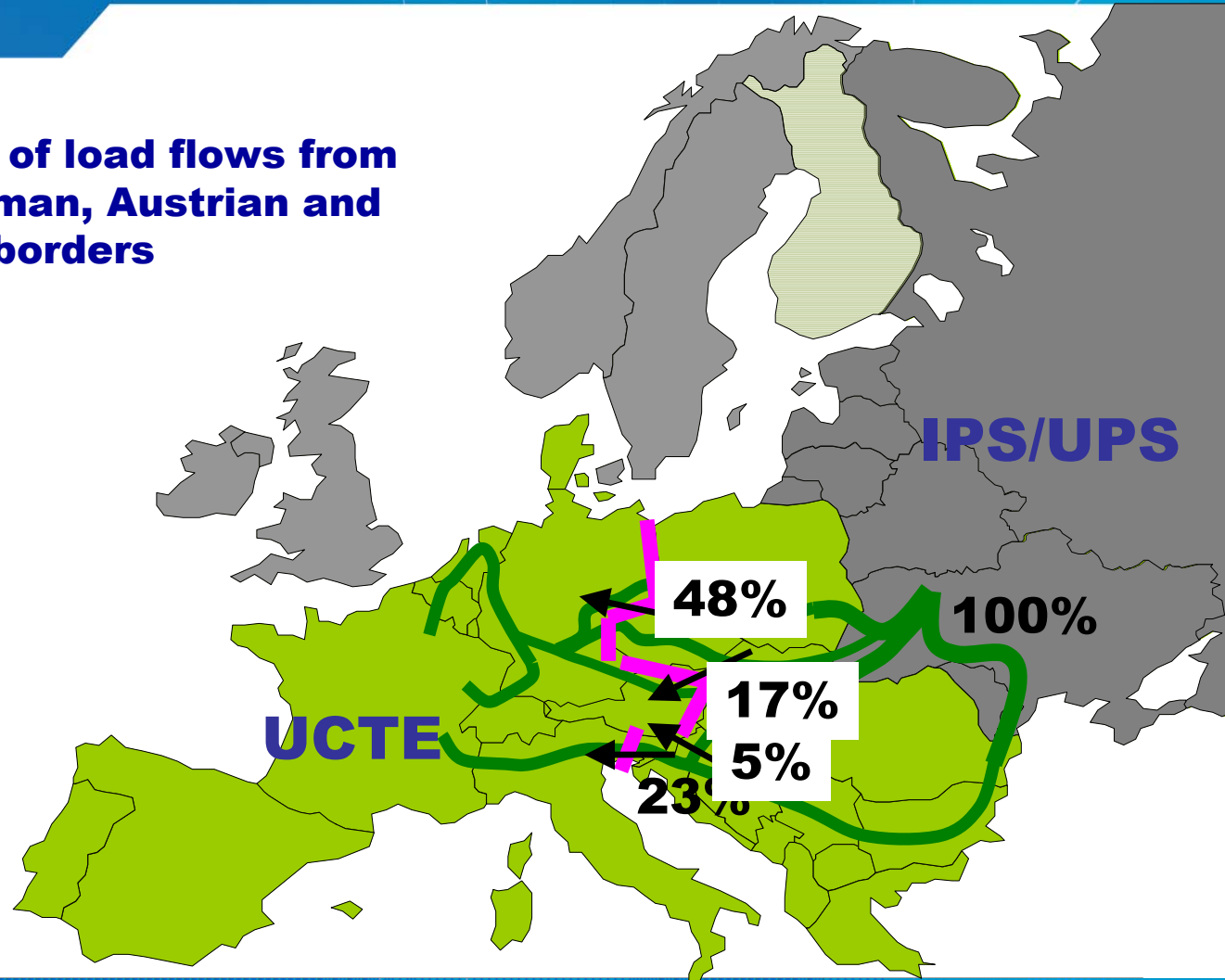
**Published NTC-values (ETSO),
Winter 2002/03 for the profiles:
PL+CZ to D,
CZ+H to A,
SLO to I**



Pre-feasibility study: conclusions

Sharing of the load flow through existing bottlenecks

**Distribution (%) of load flows from
IPS/UPS on German, Austrian and
Italian Eastern borders**



Pre-feasibility study : conclusions

Transits from IPS/UPS must pass congested lines !

<u>Congested lines</u>			<i>Present NTC value</i>	<i>additional transit</i>
Czech Rep. + Poland	⇒	Germany	2,500 MW	+ 48 %
Czech Rep. + Hungary	⇒	Austria	600 MW	+ 17 %
Slovenia	⇒	Italy	380 MW	+ 23 %

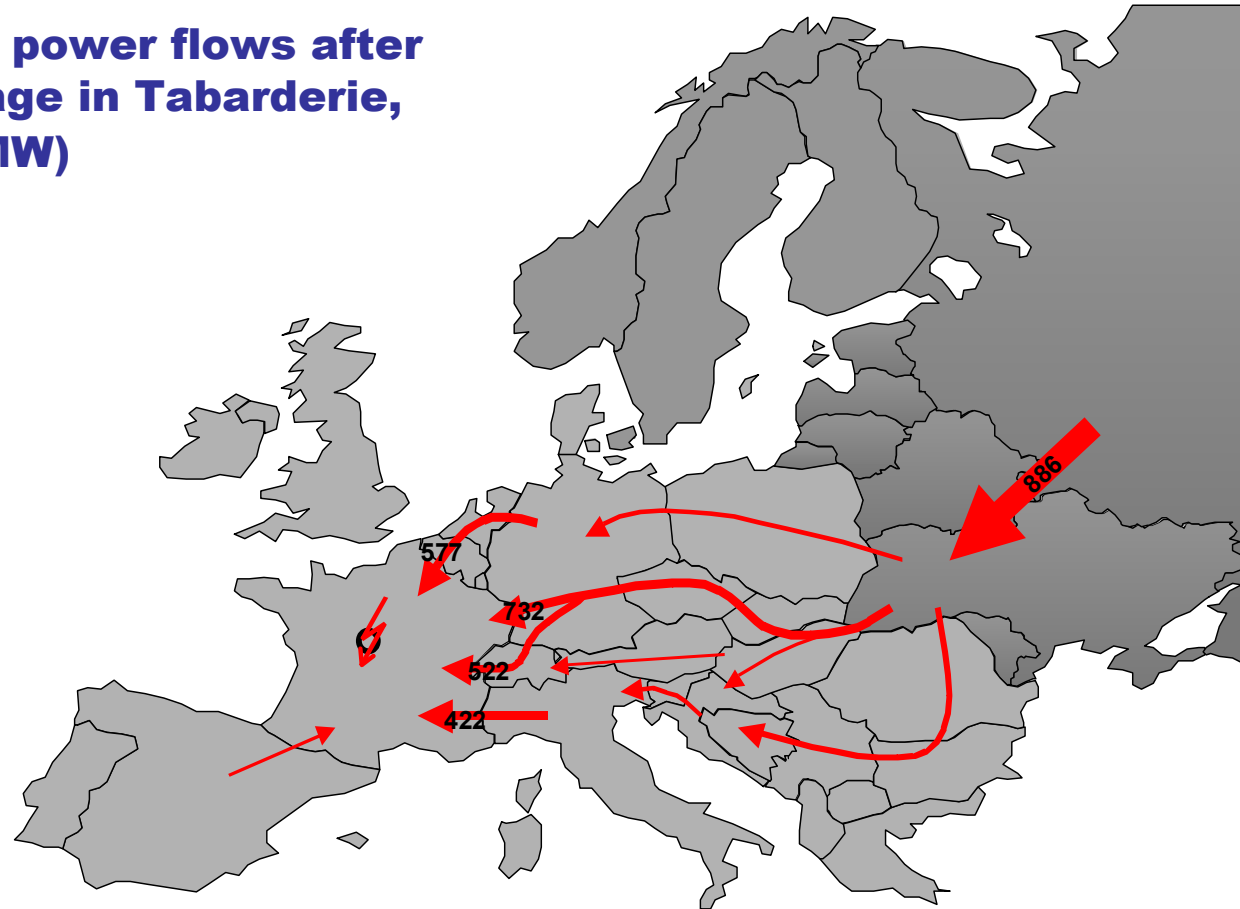
- **There are no significant changes of NTC-values in the future.**
- **The bottlenecks on the “congestion line” are working at full capacity.**
- **The East-West transits cannot be increased significantly in the future.**
- **Therefore, import from IPS/UPS would replace mainly generation in the eastern part of UCTE.**



Pre-feasibility study: conclusions

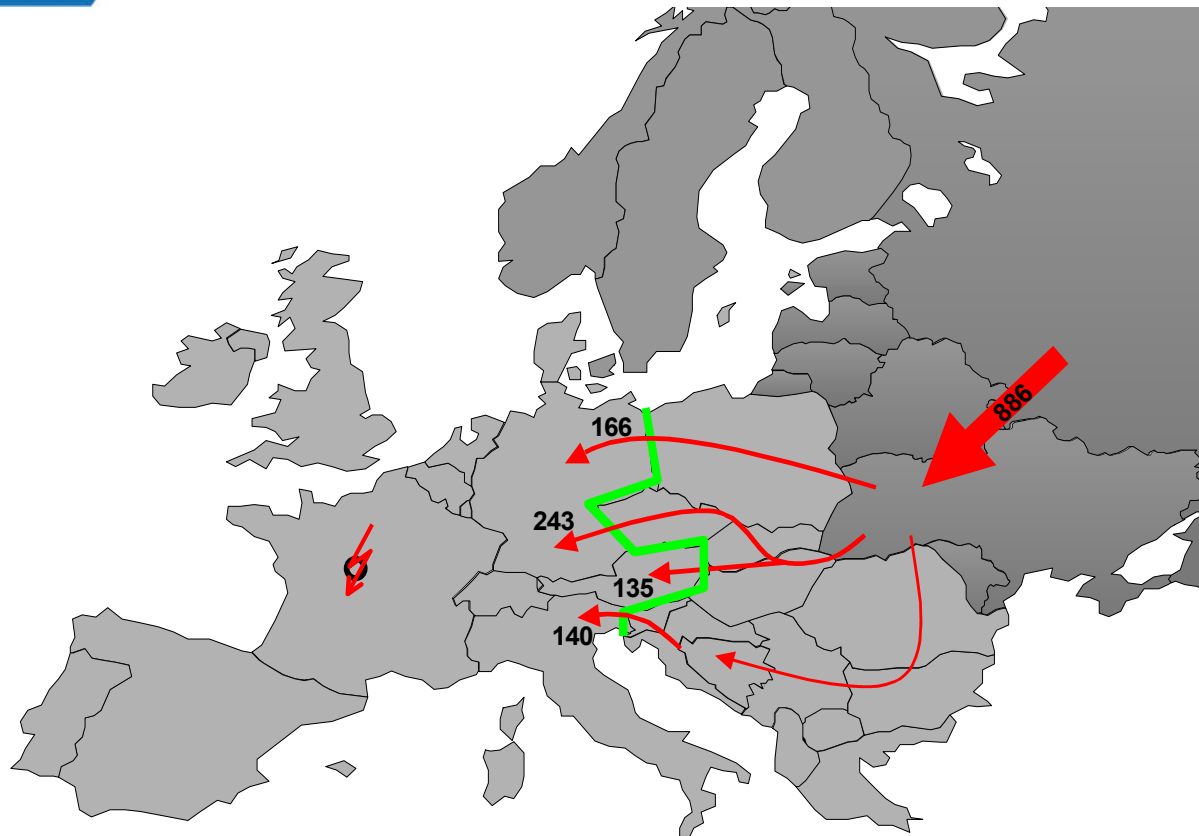
Primary control power flow with IPS/UPS

**Primary control power flows after
generation outage in Tabarderie,
France (3,000 MW)**



Pre-feasibility study: conclusions

Additional primary frequency-control power flows (MW) with the
IPS/UPS system synchronized



Pre-feasibility study: conclusions

Primary control from IPS/UPS must pass congested lines.

		<u>additional LF with IPS/UPS</u>	<u>present TRM-value</u>
Czech Rep. + Poland	⇒ Germany	410 MW	280 MW
Czech Rep. + Hungary	⇒ Austria	140 MW	240 MW
Slovenia	⇒ Italy	140 MW	170 MW

- **Transmission capacity of around 700 MW must be provided for regulating purpose.**
- **TRM (Transmission Reliability Margin) has to be adapted.**
- **The available capacities for transits would be lower to increased TRM.**

Pre-feasibility study: conclusions

- **Central European grids are already operating near the limits.**
- **These limits on the congested borders cannot be exceeded.**
- **Therefore, East-West transits cannot be increased significantly in future.**
- **The import from IPS/UPS will replace mainly generation in the eastern part of UCTE. Nevertheless, the possible power transit has to be limited considerably below the physical capacity of the interconnection lines between both systems.**
- **The synchronous interconnection requires additional transmission capacity in special areas to guarantee security of the system. This would result in lower NTC-values and additional investments over future years.**
- **The synchronous operation with IPS/UPS would decrease the transmission capacities presently available to the IEM.**

Feasibility study – Scope of work

Technical aspects

– Probabilistic congestion analysis

as a complement to the pre-feasibility study

Taking into account:

- uncertainties related to wind power generation
- long distance power flow thermal and “cut-set” limits
- maintenance schedules and forced outages
- economic data as basis for generation scenarios
- winter and summer load forecasts.

– Deterministic Steady State Analysis

- Voltage stability,
 - Voltage control and reactive power margins
- will be analyzed and simulated with an Optimal Power Flow (OPF) tool.

This analysis will enable to precise the results of the probabilistic analysis, especially:

- the total transfer capacity of each interconnection line,
- and the complementary investments in terms of voltage control.



Feasibility study – Scope of work

- **Small-signal stability analysis**
 - **Inter-area oscillations**
 - **Oscillation modes and eigen frequencies and damping ratios**
 - **Identification of remedial actions:**
 - **power system stabilizers,**
 - **limitation of power transfer,**
 - **modification of regulation strategy**
 - **Validation of results by data loggers synchronized by satellite (Wide Area Measurement Systems or WAMS).**

- **Power-frequency control**
 - **Updating of results of the 1999 TACIS study**
 - **Check of ability of IPS/UPS to deliver required primary and secondary control.**



Feasibility study – Scope of work

– Transient stability analysis

- **Analysis of behaviour subsequent to major disturbances**
- **With special attention to validation of complete data set on generation units and their control systems**

– Defence, restoration and disconnection plans

- **Updating of the recommendation of the 1999 TACIS study**
- **Definition of the criteria for disconnection of the systems**
- **Simulation of behaviour after disconnection**
- **Definition and simulation of scenarios for reconnection**



Feasibility study – Scope of work

Operational and organizational aspects

- **Data exchange between control centers**
- **Coordination of outages for maintenance**
- **Incident analysis**
- **Access to and allocation of interconnection capacity**

Legal-contractual issues

Legally binding contracts for share of responsibilities between parties and concerned market players, with respect to technical and operational requirements.

Technical project structure

