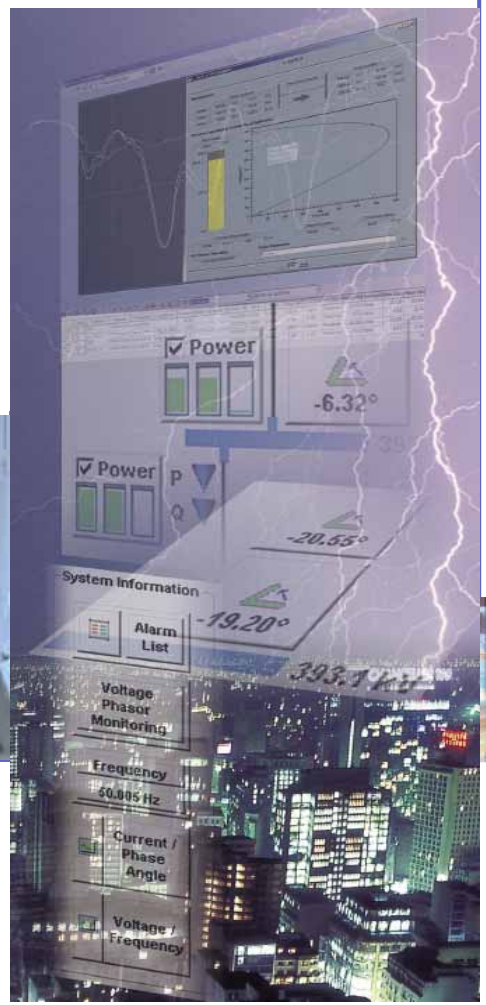
Experiences with and Outlook into Wide Area Applications



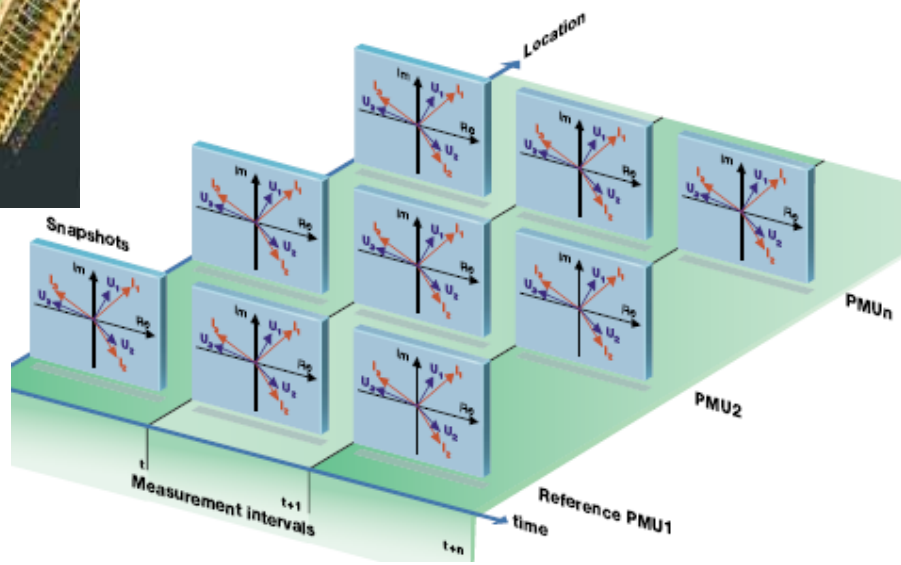
Abinee Tec 2007 April

Marcel Soares

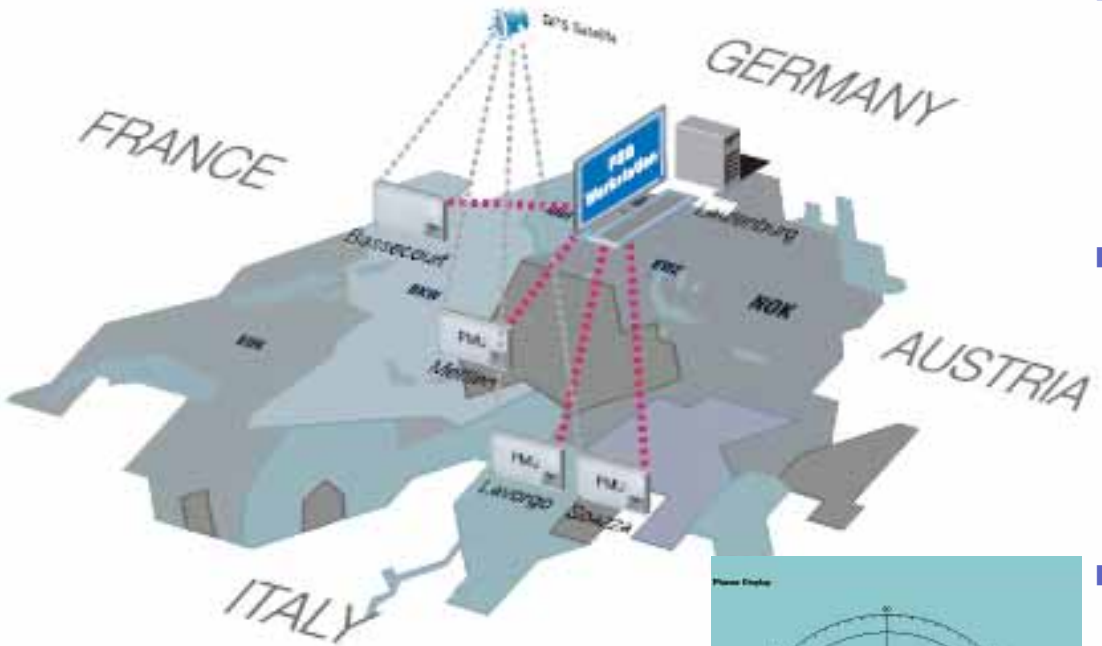
Based on the PSP 2006 Power System Protection Conference, Bled, Slovenia, 6th – 8th September by A. Surányi, P. Reinhardt, J. Bertsch.

PSGuard Technology

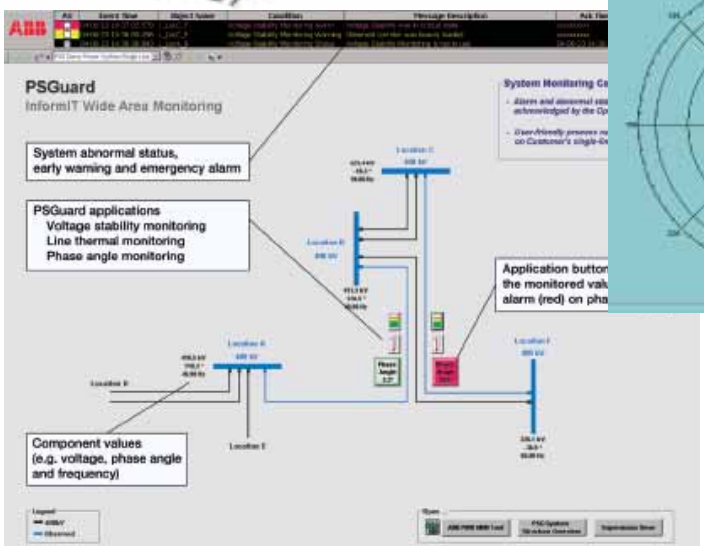
- Phase Angle Monitoring
- Line Thermal Monitoring
- Voltage Stability Monitoring
- Power Oscilation Monitoring
- Frequency Stability Monitoring
- Continuous Data Archive
- Event driven Data Archive

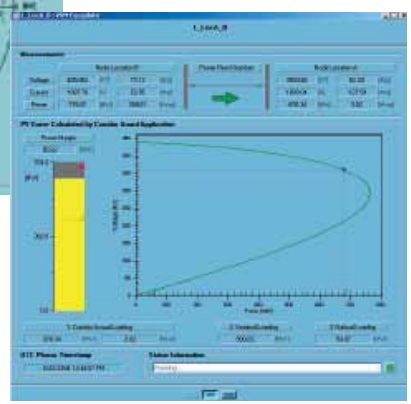


ETRANS Switzerland



- The ability to capture the the dynamics of the wide area network enhances the planning network reinforcements and extensions.
- The difference in voltage phase angles across the network is proven to be a very good indication of the network stress caused by the power export to the South.
- Network security issue because of the frequently varying stress patterns of power systems.





Blackout in italy – UTCE Report

UCTE Union for the Coordination of Transmission of Electricity
15 Boulevard Saint-Michel, B-1040 Brussels, Belgium, Tel.: +32-2-741-6940, Fax: +32-2-741-6949, www.ucte.org

The Committee identified 4 main reasons for the fact that things did not go as foreseen.

Main reasons for the blackout

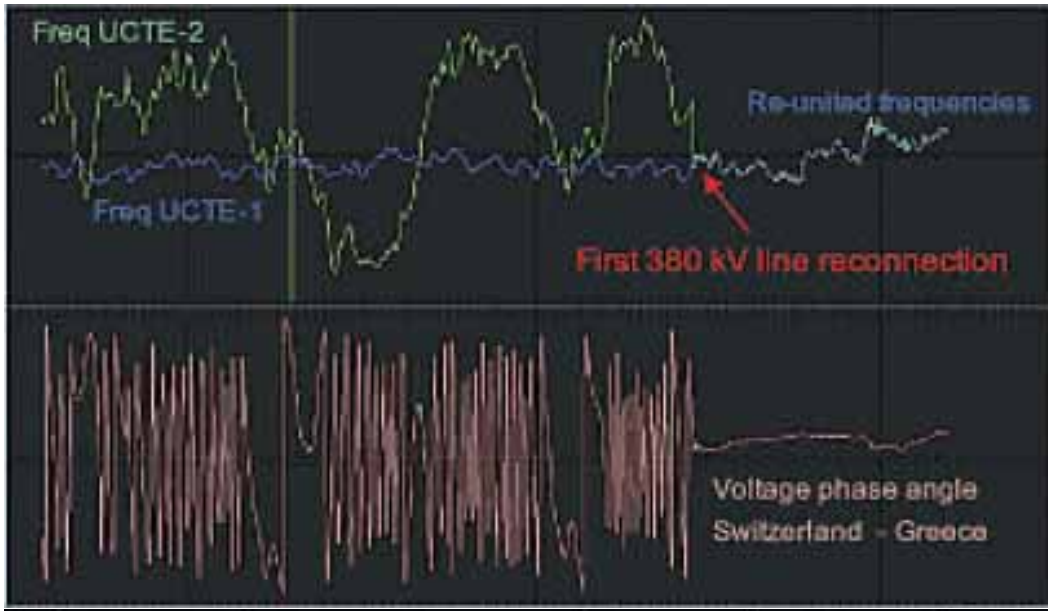
1. **Unsuccessful re-closing of the Mettlen-Lavorgo line because of a too high phase angle difference**
   Due to the high loads on the remaining lines, an automatic device, aiming at protecting the equipment, blocked, according to its design settings, the possibility of restoring the line back into service.

2. **Lacking a sense of urgency regarding the Sils-Soazza line overload and call for inadequate countermeasures in Italy**
   The operators were unaware of the fact that the overload on Sils-Soazza was only sustainable for about 15 minutes. A single phone call by ETRANS took place 10 minutes after the trip of the first line. ETRANS asked for the imports to be decreased by 300 MW. This measure was completed by GRTN within 10 more minutes. Even together with the Swiss internal countermeasures, it was insufficient to relieve the overloads.

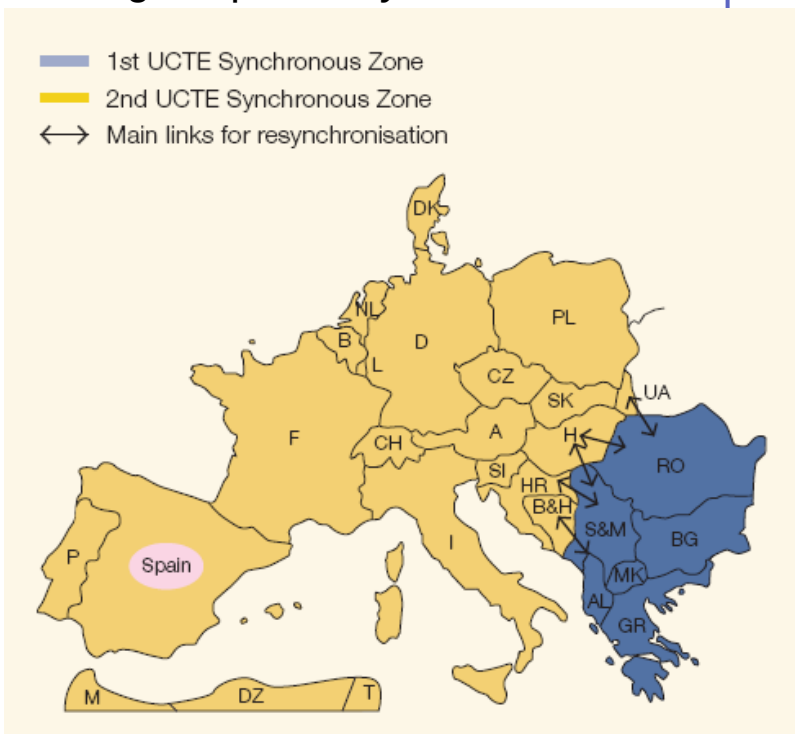
3. **Angle instability and voltage collapse in Italy.**
   As explained in the sequence of events, this was the reason why the Italian system collapsed after its separation from the UCTE system. It was not the cause of the origin of the event.

4. **Right-of-way maintenance practices.**
   Tree cutting, to maintain safe distances regarding flashover, is subject to national regulation. Therefore, the Committee did not examine these practices.

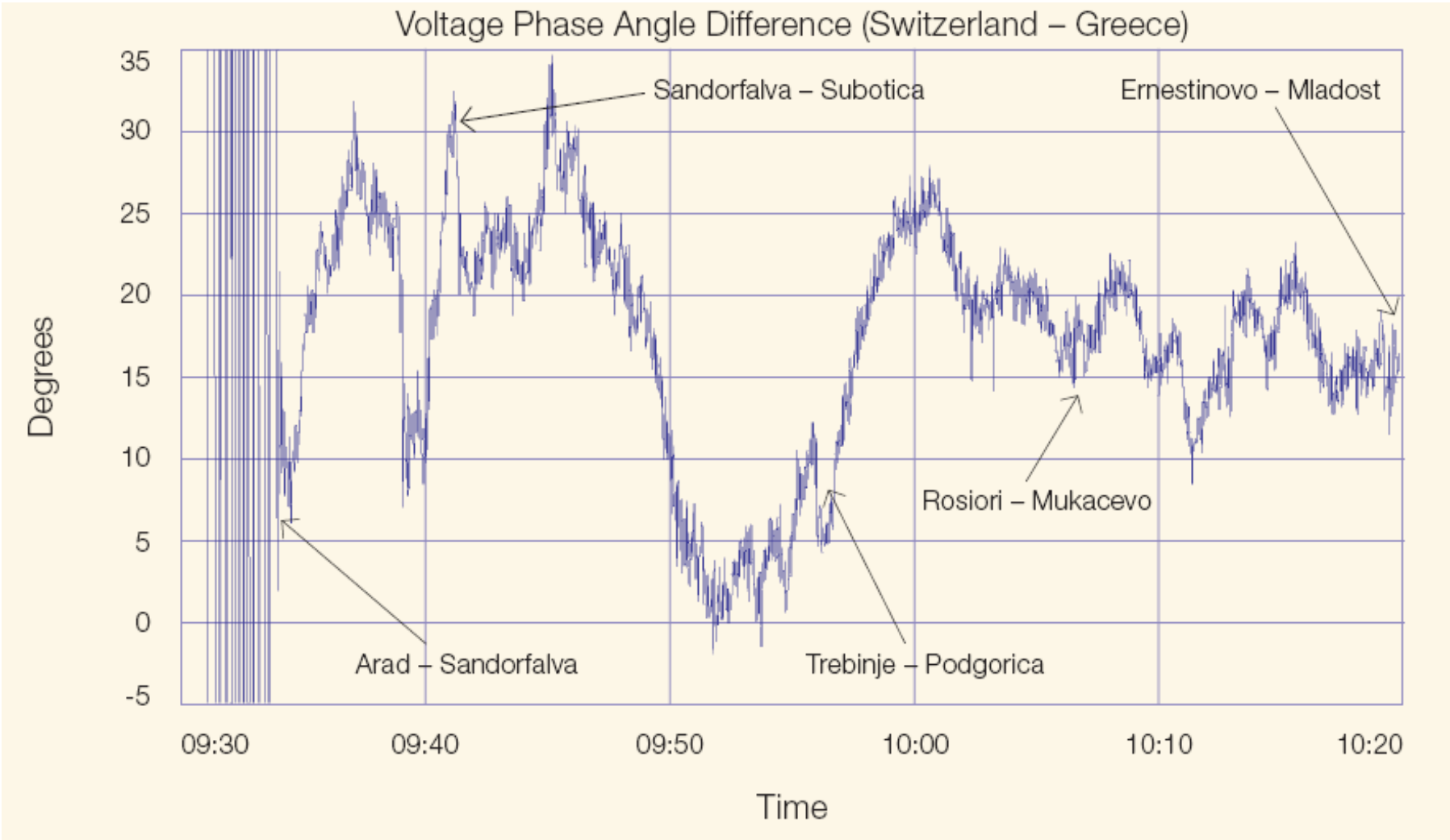
UCTE Interconnection



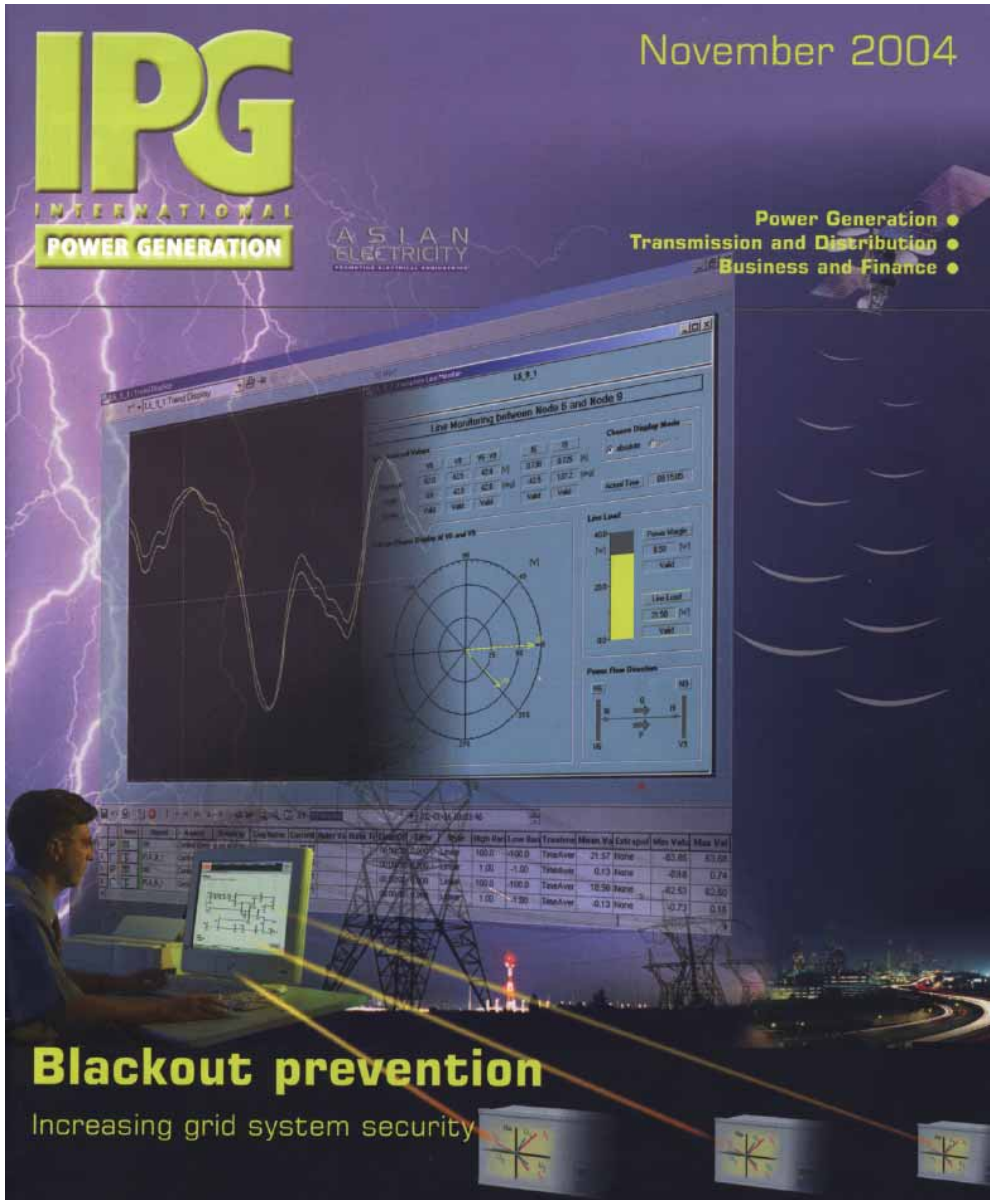
- Elative weak interconnections between wide areas.
- Power flow is umpredictable, for critical decisions always requires actual status, i.e. Belgium power system.



UCTE Interconnection



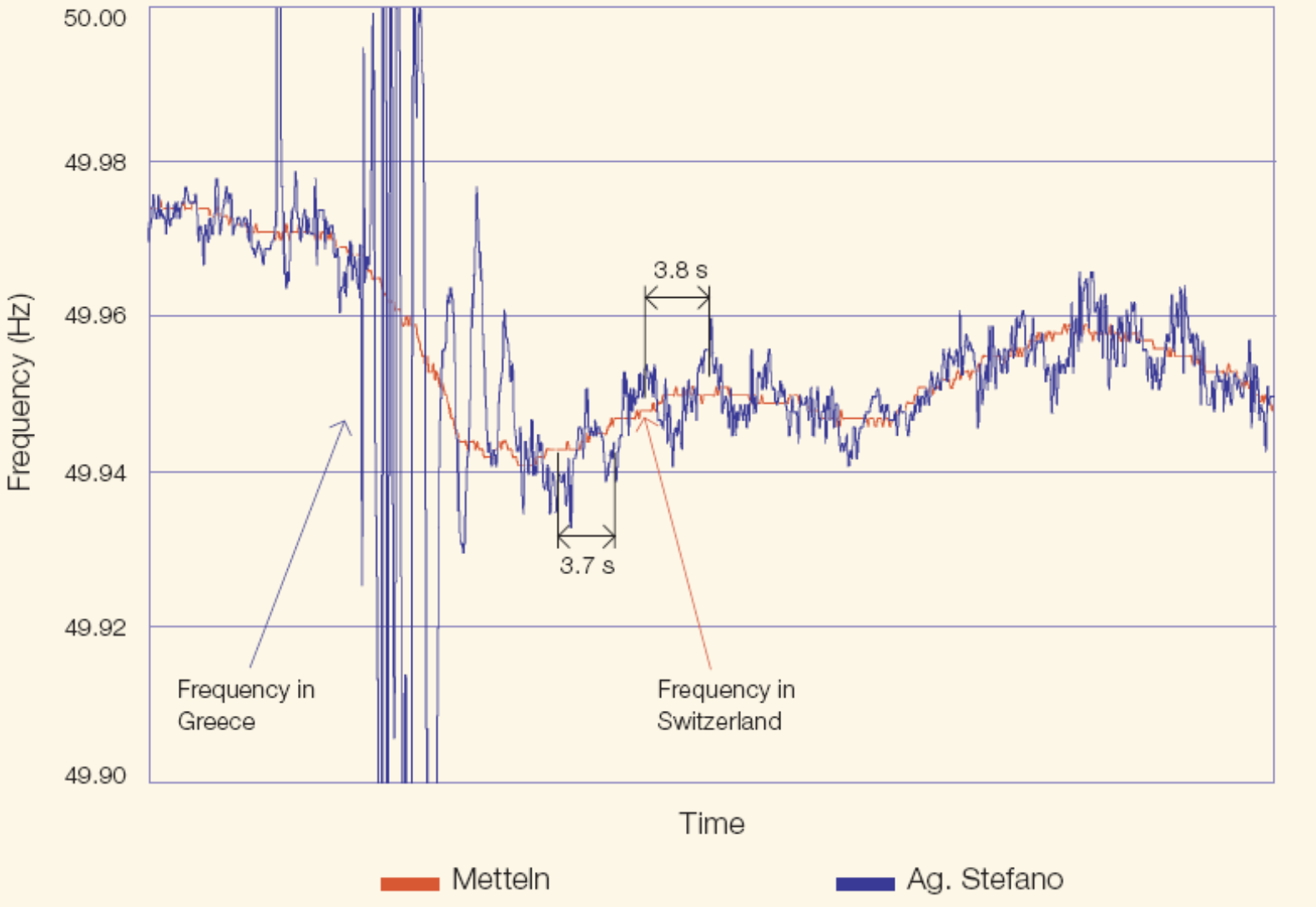
IPG Note



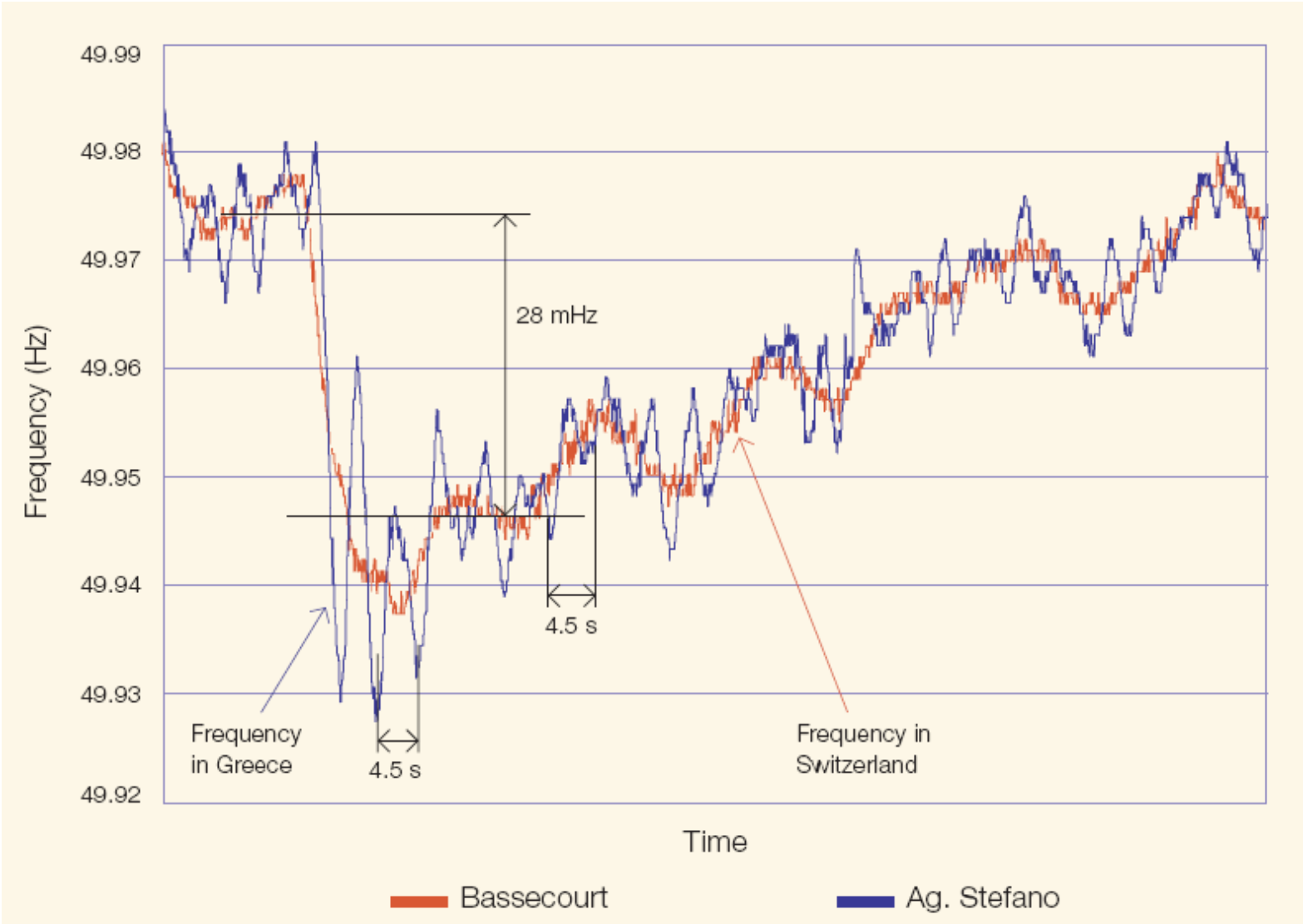
- Relative weak interconnections between wide areas.
- Power flow is umpredictable, critical decisions always requires actual status.

  i.e. Belgium power system.
- Operators lack on real time power system information.

Event Recording !
Power plant outage in Greece (650 MVA)



Event Recording !
Power plant outage in Spain (1000 MVA)



Technology Review

“10 EMERGING TECHNOLOGIES THAT WILL CHANGE YOUR WORLD”

“We can push more power, through the grid while, at the, same time,making the system more predictable and more reliable.”

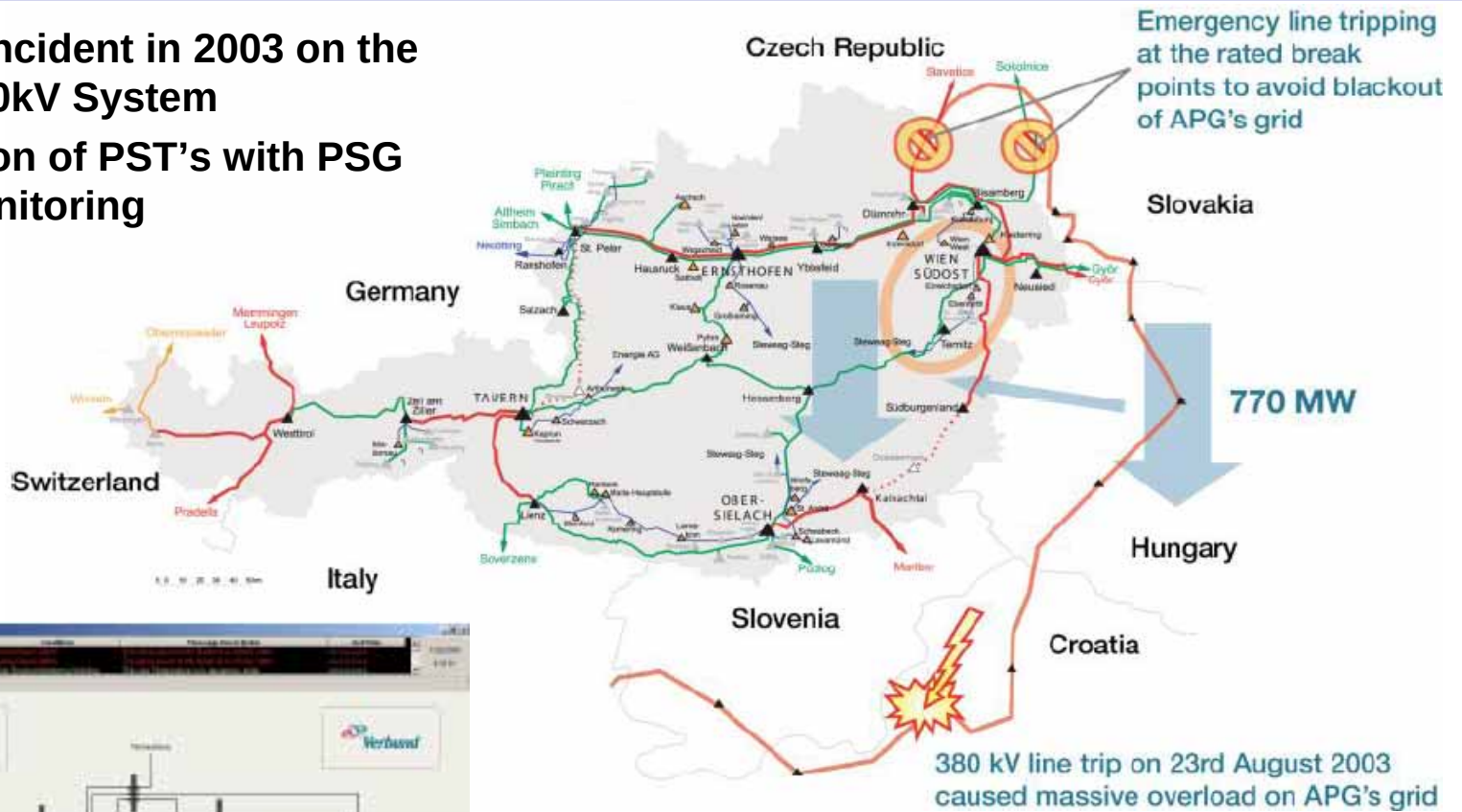
CHRISTIAN REHTANZ,
Group assistant vice president for power systems technology

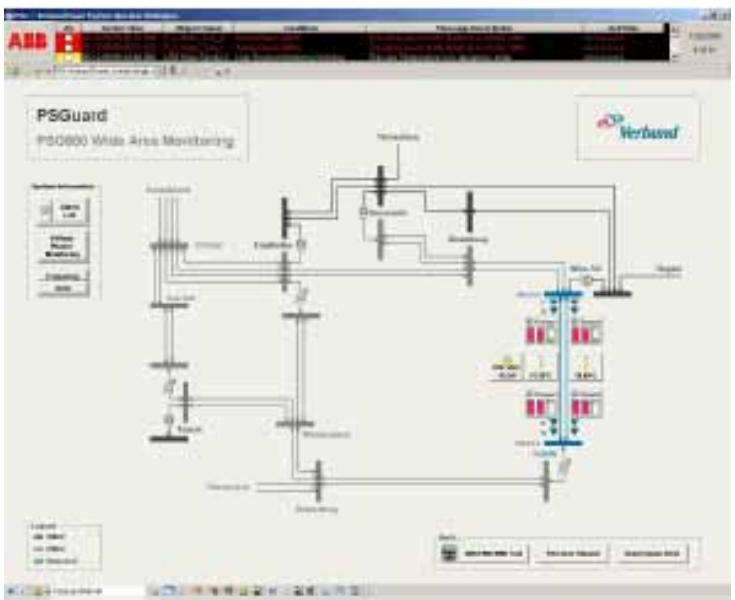
“Control algorithms designed by Rehtanz and his colleagues employ a highly simplified model of how a grid works, but one that they believe is nevertheless capable of instantly identifying serious problems brewing and on a standard desktop computer.

ABB engineers are now studying how such algorithms could protect a critical power corridor linking Switzerland and Italy that failed last September, blacking out most of Italy”

APG 220kV Grid Monitoring

- **Severe incident in 2003 on the weak 220kV System**
- **Instalation of PST's with PSG VSM monitoring**



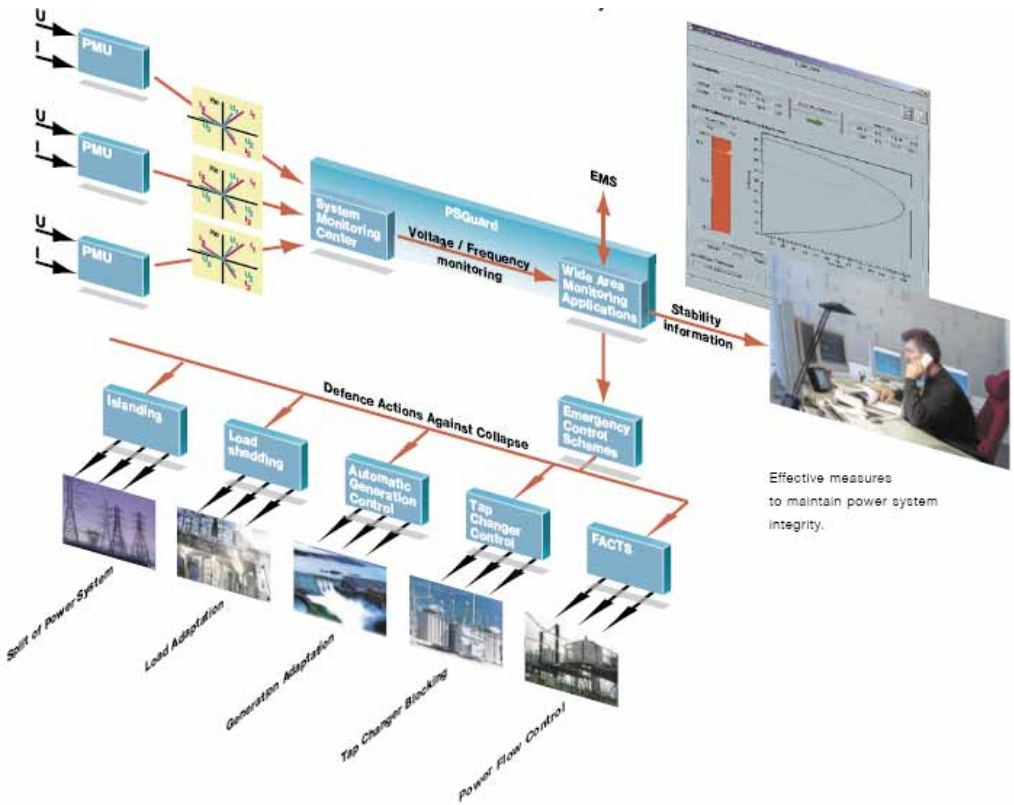


- **Optimize use PST's**
- **Extend close loop with the SCADA/EMS.**
- **Increase security on scheduled mantainnance and grid layout changes**

EGAT 500kV Corridor Thailand - Malaysia

- **TH – MY Corridor was a source of strong power oscilations.**
- **Limitations of power exchange via the DC to Malaysia**
- **Instalation of ABB PSG enable critical time responce to stabilize the system with capacitor banks.**
- **Due to accumulated know-how with real time monitoring,EGAT is considering to automate this procedure with wide area control**

Outlook to Wide Area Protection & Control



- **Avoid pre-foult constrains**
  - Thermal capacity limits
  - Stability of power generation
  - Low local system voltages
  - Potential overloading of power system parts
- **Demands enhanced reliability, security, redundancy, as well as processing and communication speed compared to monitoring infra structure.**
- **Implementation of Emergency Control Schemes:**
  - Islanding
  - Load adaptation
  - Generation adaptation
  - Tap changer blocking
  - Power flow control, i.e. active and reactive power

Credits

- **Andreas Surányi**

- **Petra Reinhardt**

- **Joachim Bertsch**