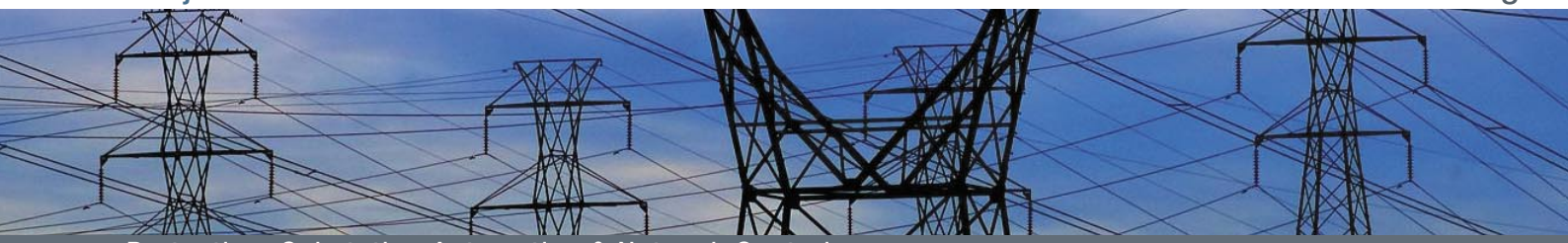
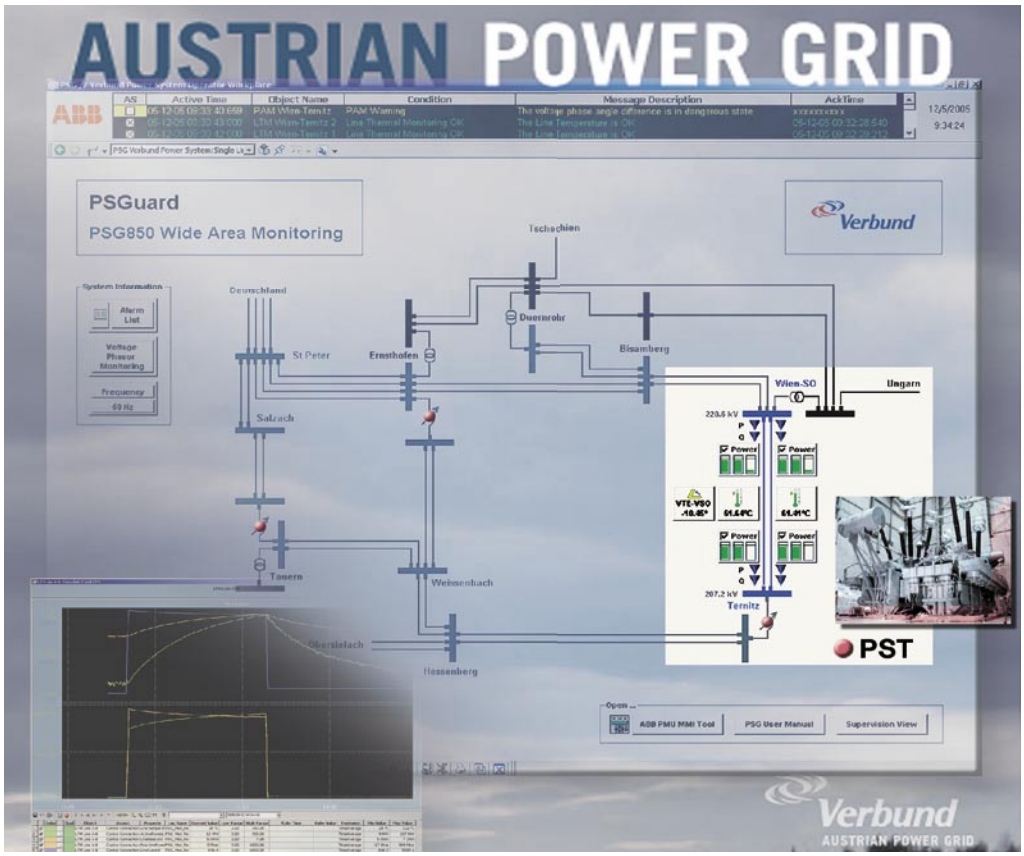


Protection, Substation Automation & Network Control

APG* enhances the monitoring of an important 220 kV corridor with PSGuard



Customer statements:

„After thorough evaluation, we have decided to realize a first phasor measurement installation and monitor the heavily loaded corridor between Vienna and Ternitz with on-line applications. The information especially on the load flow and average temperature progression on the double lines will aid our operational staff in fully utilizing their transmission capacity and maintaining integrity at the same time“, says Mr. Herbert Erven, Head of the secondary systems section at VERBUND—Austrian Power Grid AG.

Austrian Power Grid AG (APG)* introduces ABB‘s PSGuard Wide Area Monitoring System (WAMS) to support its operators with:

- Detecting and counteracting evolving contingencies and overload situations
- Improved operation of the vital Vienna-SE—Ternitz 220 kV double line with applications like phase angle difference and line thermal monitoring
- Gaining experience and data to optimize the north-south power flow through the use of three phase-shifting transformers being installed in 2006

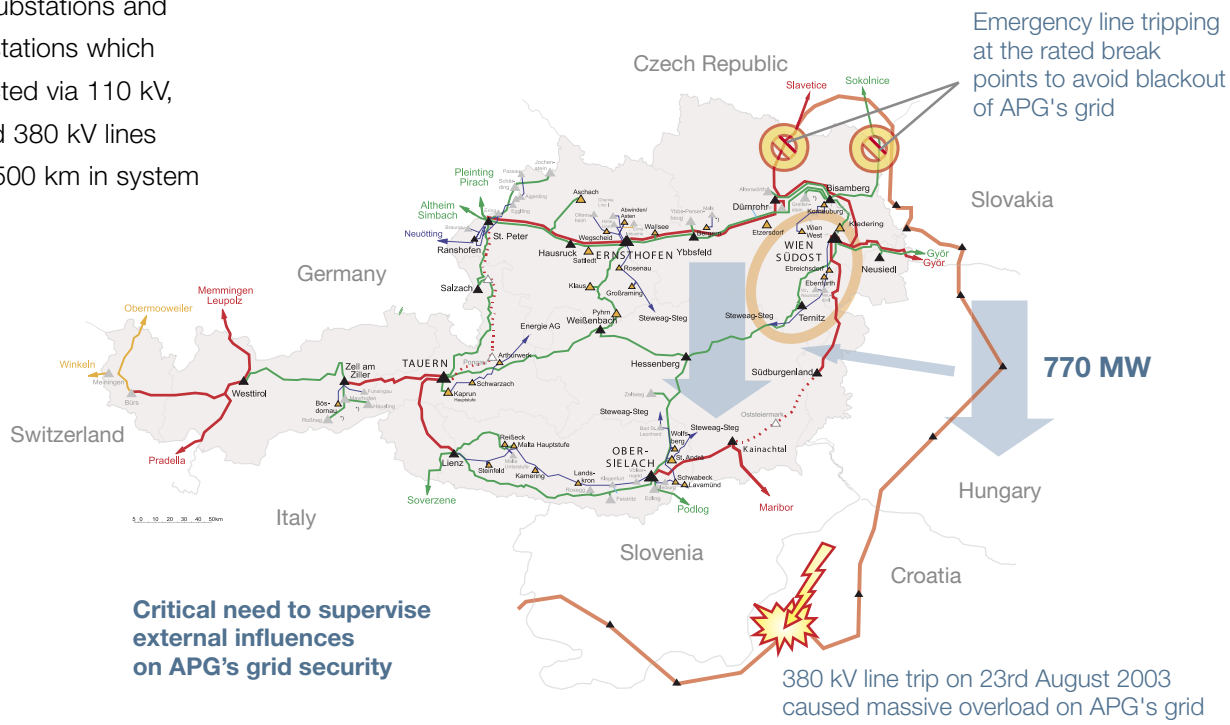
The PSGuard at APG is the third such system installed within the network of UCTE (Union for the Coordination of Transmission of Electricity) in Europe

The Customer

Austrian Power Grid AG (APG) is a subsidiary of VERBUND, the largest producer and distributor of electrical energy in the country's deregulated market. Headquartered in Vienna, the TSO plans, operates and maintains the super-regional high voltage and extra-high voltage grids with ties to all neighbouring countries. APG ensures the safe, economical and environmentally friendly transport of approx. 33,110 GWh to its customers per annum. Most of this electric power is produced by the VERBUND subsidiaries AHP and ATP with around 22,700 and 5,500 GWh being generated in 88 hydroelectric and 17 thermal power plants, respectively. APG operates some 46 substations and switching stations which are connected via 110 kV, 220 kV and 380 kV lines totalling 6.500 km in system length.

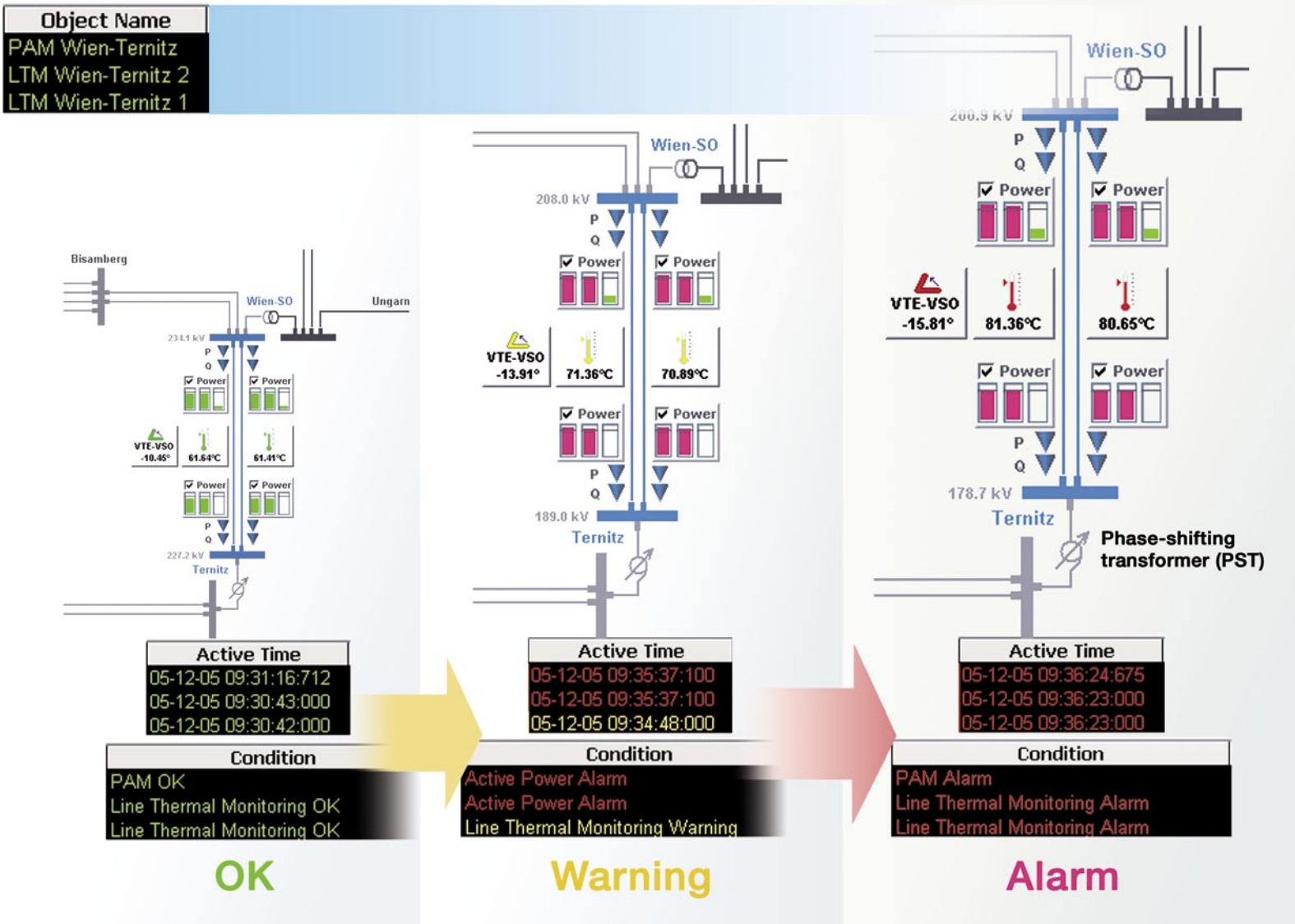
The Challenge

A production surplus of 1900 MW in North-Eastern Austria and a 1400 MW deficit in the South of the country bring about heavy power transfers via the three 220 kV north-south line connections with a total capacity of 1200 MW. Increasing congestion restricts electricity flows and reduces security of supply. The addition in 2006 of 1000 MW wind generation in the northeast and shutdown of coal-fired stations in the south will further aggravate the situation. Alleviation through required line upgrades to 380 kV and completion of the high-performance 380 kV line ring is imminent. Meanwhile, bottleneck management with emergency measures at power and distribution stations helps to scantily maintain network operation at exploding costs. These lead to rises in network cost and electricity prices, while the supply certainty drops. Network operators require support with maximizing transmission as well as detecting and counteracting evolving disturbance and overload situations.



Critical need to supervise external influences on APG's grid security

380 kV line trip on 23rd August 2003 caused massive overload on APG's grid



PSGuard Line thermal (LTM) and Phase angle (PAM) monitoring: Example of an escalation from normal to alarm

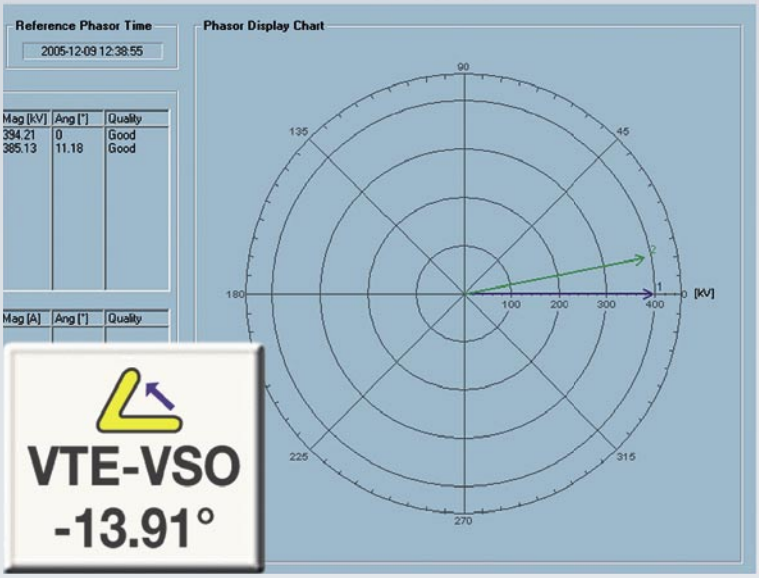
ABB's solution

The solution chosen for the enhanced monitoring of the operational condition of the 220 kV double line between the **Vienna South-East** and **Ternitz** substations comprises of a **PSG 850** Wide Area Monitoring System with GPS-synchronized phasor measurement units (PMUs). The on-line monitoring of phase angle differences and average line temperatures improves observability of the massively overload-prone lines and alerts operators to dangerous situations. Cognizance of the dynamic condition of the corridor allows operators to react swiftly and adequately to sudden interruptions or bottleneck situations.

PSGuard applications at APG:

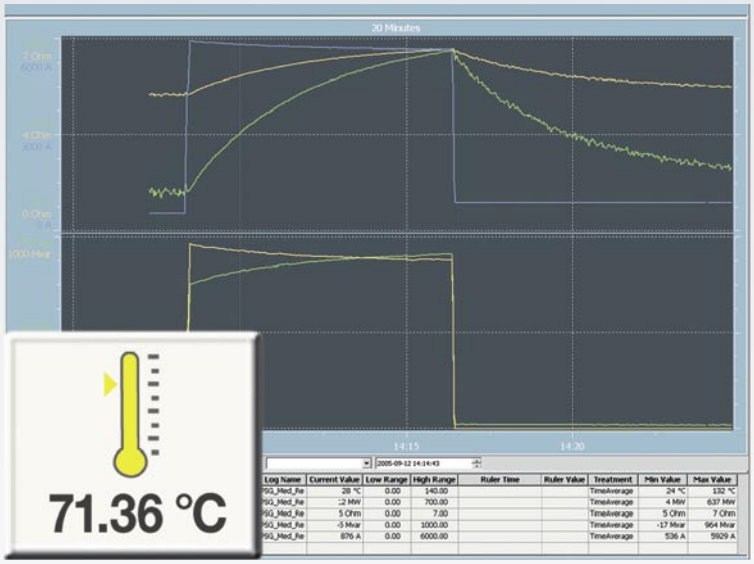
Phase angle monitoring (PAM)

The PAM application facilitates the monitoring of network stresses caused by heavily loaded lines. It provides power system operators with real-time information to evaluate the present voltage phase angle difference between two locations – a crucial issue e.g. for the successful reclosing of transmission lines. Upon detection of an extraordinary status, PSGuard alerts the operator by giving an early warning or, in critical cases, an emergency alarm. Actions that the operator may take to improve grid stability range from generation rescheduling to load shedding in extreme cases.



Line thermal monitoring (LTM)

The results of the LTM application provide better accuracy in determining the mean line temperature and changes in temperature. It computes actual impedance and shunt admittance of a line and extracts the line resistance. Based on the known properties of the conductor material, i.e. reference temperature and dependency coefficient, the actual average temperature is determined. Since PSGuard serves as early warning system in case of potential overloads, the operators gain information to initiate corrective actions and thus avoid tripping of heavily loaded lines.



Conclusion

The comprehensive system information contained in the WAMS measurements is used for enhanced monitoring as well as for alarming purposes. The mentioned applications therefore serve as decision support both in case of normal operating conditions and in emergency situations.

Future use with phase-shifting transformers (PSTs)

In a next step, further PMUs shall be placed in the Ternitz, Ernsthofen and Tauern substations with the aim of optimizing the use of three PSTs being installed in 2006. Their effectiveness shall be verified and their operation in a group coordinated with the aim to safely make full use of the available transmission capacity.

For more information please refer to the responsible ABB sales engineer for your country or to the address mentioned below.

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