PSI Energy EE

High-Quality Control Technology

For The Energy Market

PSI

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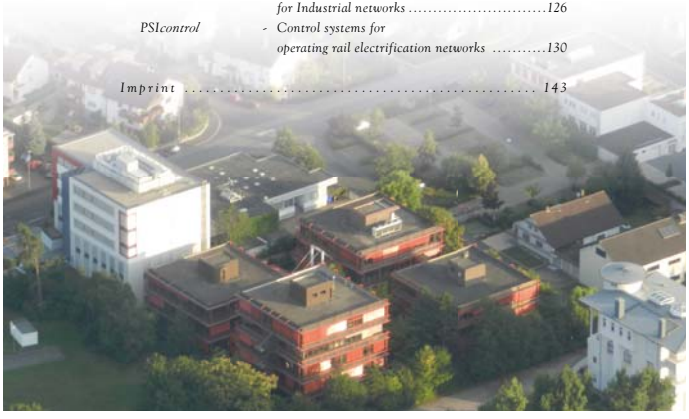


PSI Energy EE - Partner in energy technology

In the PSI Energy EE business division, more than 230 engineers, physicists, developers and mathematicians design and implement innovative high quality solutions for the energy market.

PSI Energy EE does not only work in Germany but also abroad. In accordance with the PSI Group's rules, PSI cooperates with selected partners in various countries:

- **Russia**
  OOO PSI, Moscow
- **Poland**
  PSI, Poznan
- **Southeast Asia**
  PSI INCONTROL SDN. BHD.,
  Kuala Lumpur, Malaysia
  and other companies.

Colleagues from these companies support us and you over the whole system life cycle: from sales through implementation to maintenance.

Our projects - our pride

PSI Energy EE has a well-known name in the energy industry. Many of our customers have used PSI systems for decades, some of them for more than three system generations. This shows both great recognition as well as a challenge for our team and our technology.

Even today, there is plenty of room for further development in the software and energy fields. We keep ourselves ready for any future requirements by continuously developing our technology further while questioning traditional solutions at the same time.

We are proud of our customers who continuously present us with new challenges. Our high level of creativity helps us realise demanding, tailor-made solutions in accordance with our customers' needs, which makes our daily work most interesting.

References in Germany

Transmission System Operators
380 kV, 220 kV

Distribution System Operators
110 kV, MV

Municipal Utilities
Electricity, gas, water, district heating

Rail Electrification
ZES (central control centres) and
STCC (support tool for control centres)

Our projects - our pride

References around the world

Our success in Germany proves the technical capabilities of our products and qualifies PSI to offer these products on international markets.

Looking back

In 1999, PSI was awarded a project in Austria. STEWEAG asked PSI to renew their load distribution control system. One year later, PSI was given the chance to expand the central control centre of BKW. This marked the beginning of our activities on the international market. After first focussing our sales activities on German speaking markets within Europe, we soon began to internationalise our software for delivery in the respective national languages.

Today

Meanwhile, PSI also has agencies in Russia and Southeast Asia. In order to ensure that language barriers and cultural differences do not constrain the success of a project, it is of utmost importance to work with reliable local partners. In both of these target regions, we have established solid partnerships and have already realised several projects.

PSI*control* - The control system

PSI*control* offers high-quality solutions for central monitoring and management of large energy networks.

Reliable, environmentally friendly and economically efficient supply of energy is an important obligation of any modern society. The increasingly decentralised energy generation requires innovative technological solutions.

The structural changes, caused by the everchanging energy industry, will not only affect the system architecture but state-of-the-art technology must also support the organisation and ensure the security and confidentiality of all data.

PSI*control* offers the right solutions and distinctive unique features for these manifold tasks. The product is continuously enhanced.

Thanks to our highly specialised and flexible technology and our excellent team of highly-skilled experts, our customers have entrusted us with projects in various business fields for many years:

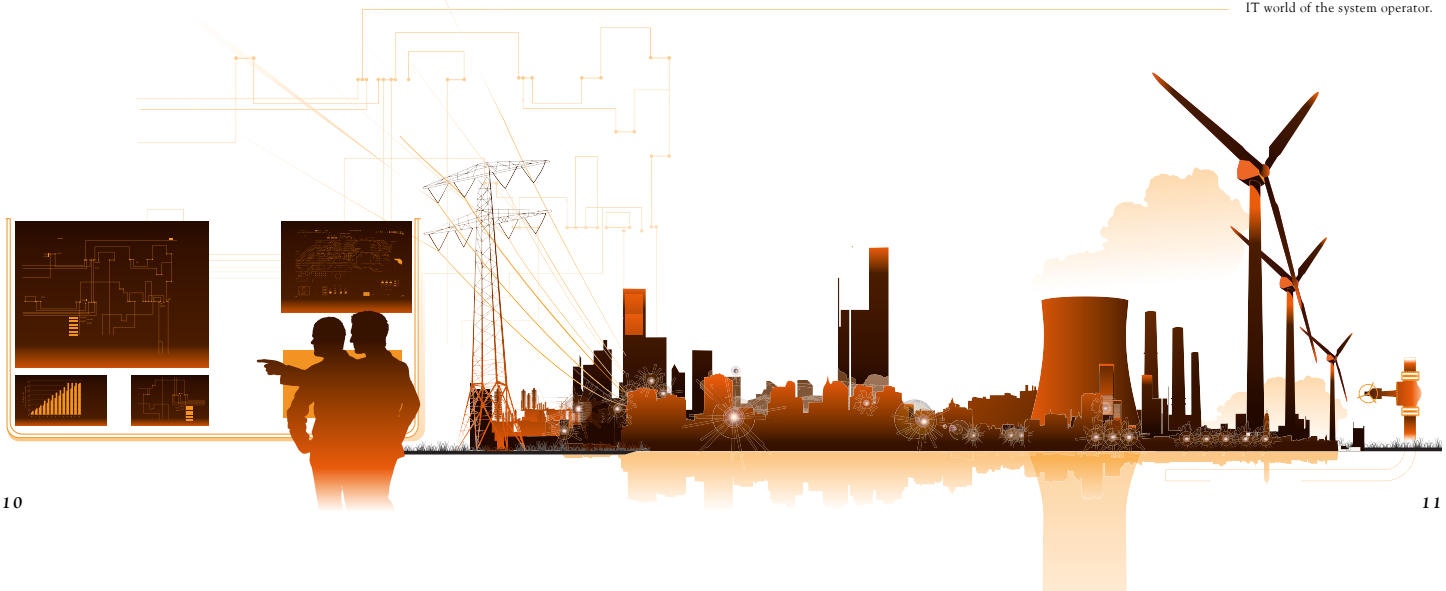
- Electrical transmission networks,
- Regional electricity distribution networks,
- Combined energies networks for the supply of electricity, gas, district heating and water,
- Industrial networks and
- Rail electrification networks,

PSI*control* is a software designed to operate local as well as distributed control systems. Picture concepts and graphical user interfaces can be displayed in a variety of systems from monitors to large rear projection video walls.

Due to the functionality and great flexibility of the PSI*control* process interface, it is possible to connect central as well as decentralised RTU system setups in many ways. Even in very large networks PSI*control* offers extremely short response and processing times and is highly available at all times.

The PSI*control* product family offers different solutions for expansion which go beyond the world of SCADA and control technology:

- PSI*command* expands PSI*control* with a complete workforce management solution.
- PSI*passage* provides system operators with an innovative solution for their tasks in deregulated energy markets.
- PSI*xchange* integrates geographic information systems, ERP systems and other information systems within the IT world of the system operator.



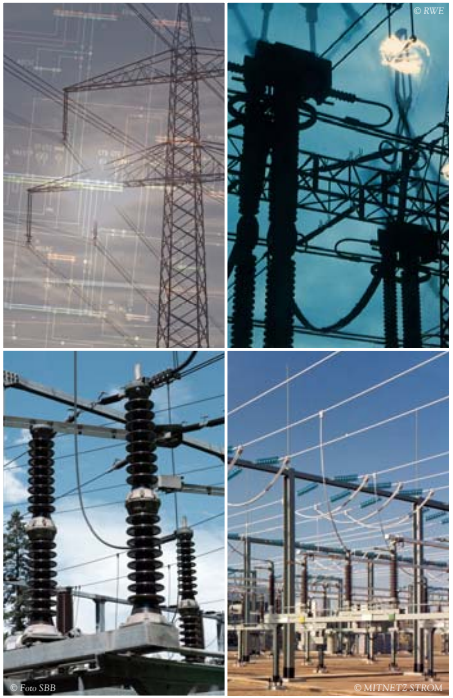
Applications for electric networks

Momentary power supply interruptions seriously affect all aspects of life. The impact on the energy provider's infrastructure is often severe and the industry is thus regarded a critical part of infrastructure.

PSI*control* is a high-end control system which works reliably even in extreme fault scenarios and provides a fast and comprehensive overview of the situation.

It effectively supports network management during fault localisation and isolation and thus helps to achieve service restoration as fast as possible.

At the same time, it provides extensive automated functions for network management to avoid distraction of the operators from their most important tasks. Outage and service restoration reports for corporate managers and government authorities are automatically generated and made available by the system.



Combined energies applications

Municipal and regional energy providers increasingly manage their networks with a combined energies control system for more than one commodity. The decision for a combined energies control system is mainly based on the cost benefits of concentrating the control technology and all accompanying organisational measures.

PSI*control*'s multinet technology has been developed specifically for the combined control of networks in several utility sectors.

The technology allows for individual commodities to be managed independently in a single control system. Its multi-client capability also supports management of third party networks.

Chosing PSI*control* with multinet applications means making a sustainable decision for the future.

Intelligent technology for Smart Grids

Electrical networks are experiencing the greatest change in history. They must become more intelligent to handle decentralised generation of renewable energy. Earlier, electricity only went in one direction: from transmission to distribution. Today, the network has not only to accommodate more wind, solar, or biomass power, but also has to cope with consumers who may become energy producers from time to time.

Volatile, decentralised and renewable are the important keywords for the new energy infrastructure. They pose new challenges for network management. Energy generation and consumption must be balanced intelligently. Due to the growing percentage of regenerative energy in medium and even low voltage networks, system operators are facing new requirements. Thus, the medium and low voltage networks require a much higher degree of automation.

Energy generation close to the consumer is on the retreat. Most efficient use of sustainable energy sources such as wind (offshore) and sun ("Desertec" initiative) demand transmission over very long distances. Thus, the integration of HVDC lines in the transmission network is being evaluated by TSOs. In addition, the efficiency of the existing power grid must be increased.

In Germany, infeed priority and compensation for electrical energy from renewable sources is regulated by the renewable energies act ("Erneuerbare Energien-Gesetz"). This law mandates that network operators must connect decentralised generators to the network even if the network must first be enhanced to actually cope with the infeed. Balancing network stability and the legal requirements is a challenging optimisation task.

PSI*control* offers a wide array of functions for these new challenges which support our customers in this new age of network management.

For operating transmission networks, our customers use a comprehensive set of functions which are fully integrated in the control system, including, for example, powerline monitoring, generation management, dynamic limit monitoring, congestion management and forecast calculations considering wind and solar forecasts. These functions are continuously enhanced to meet the requirements of our customers.

They are also adapted to meet the challenges in distribution network management. For many years, our customers have been using PSI*control* with fully integrated distribution network calculations and functions for operating low voltage networks.

During times of acute congestion in transmission and distribution networks, intelligent control functions optimally control infeeds of renewable energy.

If necessary, renewable energy generation is reduced to the least extent possible, starting with the energy generators having the largest impact on alleviating congestion.

Using PSI*control,* renewable energy is used most effectively and in an environmentally friendly way. Generation and load are optimally balanced.

Features of rail electrification networks

Rail electrification networks supply overhead powerlines of trains with electrical energy. In comparison to "normal" electrical networks, they require special features which also affect operations management.

The exposed position and mechanical stress from contacts on the locomotive increase chances for faults in the overhead powerline network. Due to the high frequency of switching operations, automation is greatly advanced in comparison to "normal" networks.

The rationalisation of rail electrification also leads to streamlining control technology. The entire 15 kV rail electrification network of the German railway (Deutsche Bahn) is controlled by only seven central control centres. Every control system is equipped with standardised control technology. Regional characteristics are implemented using the flexibility of the control system configuration and the application software.

PSI*command* - Effective workforce management

PSI*command* supports energy providers with effective in-field and workforce management. Integration of operations-relevant information, modelling of operational processes and the use of innovative technologies increase efficiency and quality of the relevant processes, such as

- Fault clearance management,
- Maintenance management and
- Crisis management.

PSI*command* is the perfect workforce management system

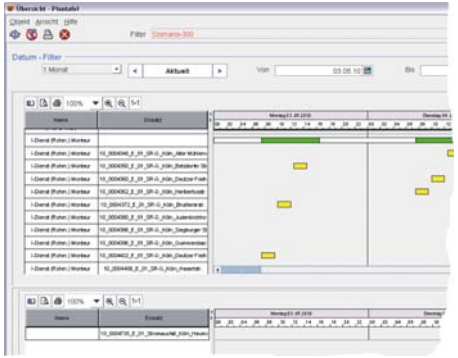
- To make multi-utility work in integrated service pools possible,
- To reduce unproductive down times,
- To document workforce management processes seamlessly and lawfully, e.g. according to TSM certification,
- To make all necessary information available in relation to the task and on all participating levels,
- And to relieve central coordination sites.

PSI*command* offers powerful interfaces to GIS, planning and business data processing systems. For example, certified interfaces to SAP systems are used amongst others.

SAP® Certified
Integration with SAP Applications

Seamless integration into PSI*control* provides additional efficiency potential (for example, for on-site switching operations and documentation of outage times). The mobile application from PSI*command* supports personnel on the spot in processing and documenting tasks using mobile devices.

The on-board unit "CommBox" was developed by PSI Nentec especially for running PSI*command* in service vehicles.



The ample benefits from using PSI*command* *are not* only available to energy providers. PSI*command* is also used in other industries with distributed infrastructure (for example, telemetry and mining).

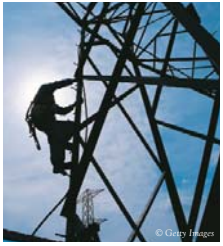
Our customers of many years recommend PSI*command*:

Fault clearance management

The main task of fault clearance management is to identify faults and to determine and implement resulting measures for clearing these faults.

Important efficiency-enhancing functions of PSI*command* are:

- Adaptive acquisition of fault indications and automatic determination of measures,
- Situation overview based on combined geographic visualisation of fault events and network states,
- Registering telephone numbers using telephone system interfaces,
- Automatic determination of responsible engineers using definitions of regional responsibilities,
- Dispatching and alarming all service units considerung all influencing factors,
- Reducing reaction times in alarm situations (express tasks),
- On-call management,
- Time monitoring of all alarms and important information from external systems,
- Automatic identification of follow-up measures using feedback from tasks completed.



Maintenance management

Ensuring the reliability and asset values as well as enhancing the structure of the network are important aspects of maintenance management.

Important efficiency-enhancing functions of PSI*command* are:

- Automatic generation of maintenance orders from cyclical maintenance plans,
- Electronic planning board for time-saving planning and dispatching,
- Automatic order planning and task dispatching with Qualicision® based criteria, such as
  - Minimising journey times,
  - Combining maintenance tasks in order to minimise switching operations and outages,
  - Optimal use of staff member qualifications and resources
- Dynamic utilisation of off-peak times,
- On-site documentation of task progress on mobile devices.

Crisis management

Crisis management includes all support functions required for managing and resolving multiple or serious fault scenarios. This may also require modifications to the operational structure.

Important efficiency-enhancing functions of PSI*command* are:

- Determining and visualising the degree of supply based on different criteria, such as
  - Organisational areas or
  - Country, state and community borders,
- Identification of fault triggers and generation of corresponding notifications,
- Illustration of crisis organisations and action plans for crisis situations,
- Geographic display of weather and lightning information.
- Automatic generation of e-mails, fax, or text messages with recipient-specific situation updates for
  - Crisis teams,
  - Decision makers,
  - Public relations or
  - Rescue services;

PSI*passage* - Systems for deregulated energy markets

With the PSI*passage* product family, PSI provides network system operators with innovative solutions for the deregulated energy markets. The relevant business processes are optimally supported by modular and individually configurable components for both transmission and distribution level.

These business processes are characterised by complex communication for exchanging energy, master and contract data between the various market participants. All PSI*passage* systems are specifically designed to support these communication processes.

The following characteristics and functions are some of the most significant highlights:

- Full automation of market communication (parameterisable),
- Parameterisable checks and system responses,
- Configurable communication channels,
- Flexible conversion technology as well as
- High-performance processing of mass data.

In addition, flexible tools for data analysis are available to the user. The available analysis templates can be integrated into automated export jobs and thus be used for internal or external reporting.

The intelligent open system architecture is the basis for modifications to meet new requirements. Changes and expansions can be made quickly to react to changing market processes.

The technical implementation as a software cluster supports operation in a high-availability environment. This allows for load distribution to various hardware resources. Further hardware resources can be easily integrated in response to increased performance requirements.

Our customers of many years recommend PSI*passage*:

TRANSNET BW

PSI*passage*-T
- Schedule management
- Regulating power management
- Congestion management
- Wind / PV marketing

tennet

PSI*passage*-T
- Schedule management
- Regulating power management

PSI*passage*-ACC
- Accounting of unintentional deviations

50hertz

PSI*passage*-T
- Schedule management
- Regulating power management
- Network trading management

amprion

PSI*passage*-ACC
- Balance group operation / accounting

Netzgesellschaft Düsseldorf mbH

PSI*passage*-D
- Network utilisation management
- Energy data management

KVNetz
KEVAG Verteilnetz GmbH

PSI*passage*-D
- Network utilisation management
- Energy data management

creos

PSI*passage*-T
- Schedule management

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The PSI*passage* product family

PSI*passage*-T

Support for transmission system operators

Schedule management
- Market communication via *ENTSO-E Scheduling System* (ESS)
- Automatic nomination processing
- Automatic day ahead-/intra-day group coordination according to „SO-SO matching“
- Monitoring of nomination and coordination processes
- Handling status requests

Congestion management
- Market communication via *ENTSO-E Capacity Allocation and Nomination* (ECAN)
- Calculation of transmission capacities (NTC, ATC, OC)

Regulating power management
- Allocation (primary, secondary, tertiary regulating reserve)
- Activation of tertiary regulating reserves

Network trading management
- Management of own balance groups

Wind / PV marketing
- Processing EEG forecasts
- Support for EEG marketing

PSI*passage*-ACC

Energy accounting management and accounting for transmission system operators

- Balance group accounting and market communication based on MaBiS (German market rules for electricity balance group accounting)
- Accounting of renewable energy and cogeneration volumes
- Accounting of unintentional power exchanges

PSI*passage*-D

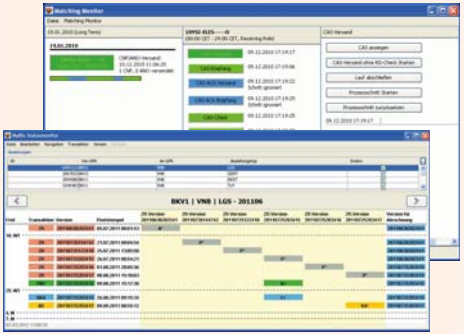
Energy data management for distribution system operators (electricity / gas)

- Master data and contract data exchange processes based on GPKE (business processes for customer delivery of electricity to customers) and GELI (business processes and data formats when changing supplier for supply with natural gas)
- Balancing and market communication according to MaBiS and GABI (basic model of clearing payment and balancing rules in the gas sector)
- Surplus/shortage calculation

Process monitors

For observing supported business processes (for example, MaBiS, schedule exchange according to ESS), PSI*passage* systems offer intuitive user interfaces.

Along with the visualisation of the process status, these provide the user with manual access to the process flow allowing quick reaction to unforeseen events.



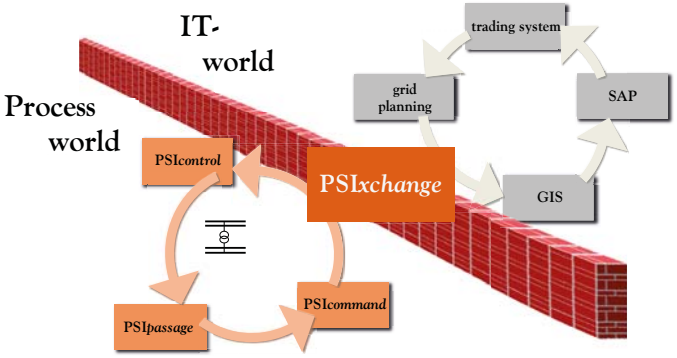
PSI*xchange* - Secure connection with company IT in PSI*control* systems

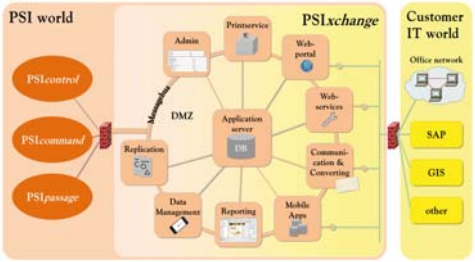
The increasing reporting and publication requirements on system operators demand access to control system data by users in the office environment. Various applications in the company's IT environment require additional access to this data. Also, data transmission from external systems must be guaranteed.

These new requirements also pose challenges for IT security. Both internal and external attacks as well as insertion of false data must be prevented.

PSI*control*, PSI*command* as well as PSI*passage* use PSI*xchange* as an integral component of the corporate infrastructure for information, communication and task management.

PSI*xchange* creates a general data exchange infrastructure for PSI*control*. With PSI*xchange* a web presence for publication of information about PSI*control* can be created easily.





PSI*xchange*
Functions and services

PSI*xchange* offers many standard functions and services as well as additional options. The service oriented architecture allows PSI*xchange* comprehensive communication in distributed systems using the internal message bus. Modular construction allows specific combinations of services; as an open system, further adapter modules can be connected to the PSI*xchange* base module.

PSI*xchange* comprises the following functions and services:

- Administration,
  - User administration and configuration interface,
  - Status display of services and system logs.
- Replication of realtime data such as logs, state lists, realtime database, time series, master data and other database contents
- Web portal,
- Web services,
- Reporting using standard reports and custom reports from templates,
- Print services for logs, curves, diagrams,
- File transfers with transfer job management,
- Data management
  - Import from GIS, picture and master data with validation and converting,
  - also in CIM format,
- Time series, communication and converting over
  - E-mail server (POP3, IMAP), file transfers with SFTP,
  - Database tables and "flat files".

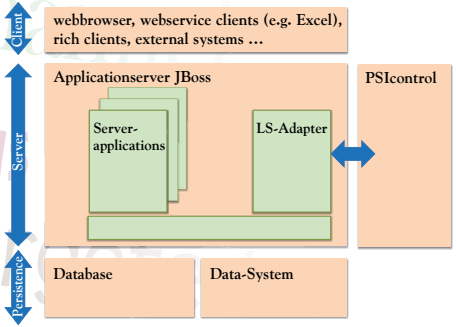
PSI*xchange* -
IT security characteristics

Due to the exposed position as the interface between the control system and external systems, special measures with regard to security and transparency of PSI*xchange* are required:

- Separation from the control system by a firewall,
- Communication with the control system using proprietary protocols and interfaces with own handshake and monitoring methods,
- Setup as application proxy with verification and conversion of all messages from and to the control system,
- Transparent processing of all external inquiries without affecting local data storage,
- Verification and conversion of import data from external systems,
- Role-based user administration with restrictions to functions and data access.

PSI*xchange* - Architecture

PSI*xchange* is designed as a "three level system" in a client-server subsystem with an application server to achieve separation from the data storage systems.



Our customers of many years recommend PSI*xchange*:

creos
VORWEG GEHEN
SWK
SBB CFF FFS
WIEN ENERGIE STROMNETZ

TSO - Applications for transmission networks

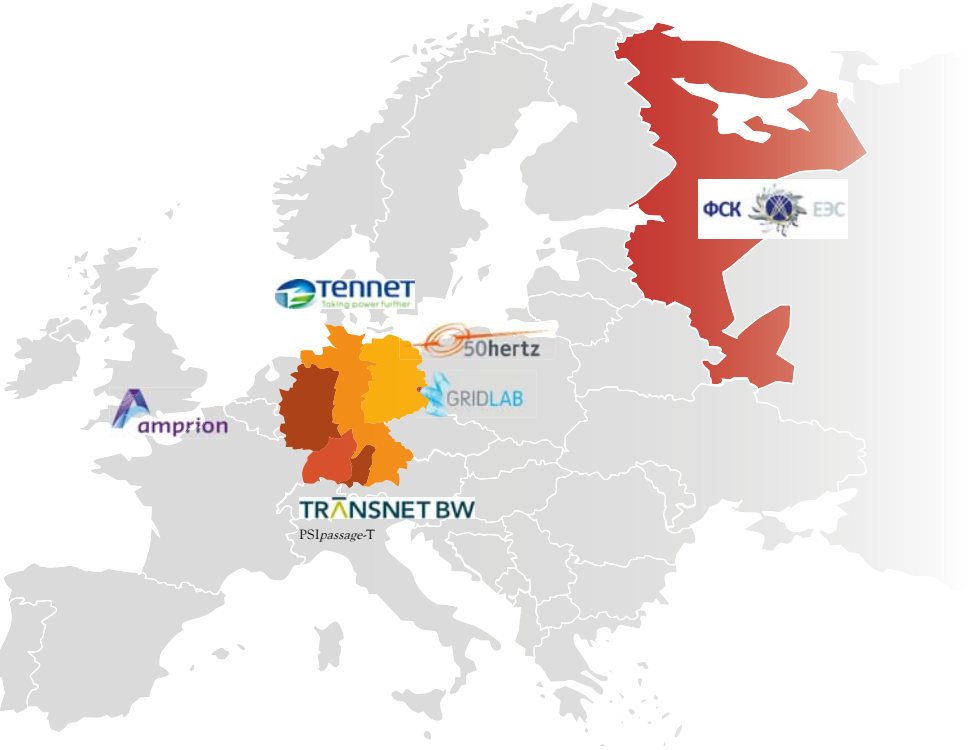
Transmission networks are the backbone of energy supply.

For the management of these networks, PSI*control* is equipped with powerful functions based on:

- PSI*control*
- PSI*passage*-T and
- PSI*passage*-ACC.

Keywords are:

- Complete network protection calculations,
- Power frequency controller,
- Congestion management (DACF, NTC, IDCF),
- Power generation management,
- Forecasts (wind).



TenneT -
Optimal network management and maintenance

TenneT TSO GmbH with its head office in Bayreuth and with about 1,000 staff members is responsible for operation, maintenance and other developments of the 220 kV and 380 kV electricity transmission networks in large parts of Germany.

TenneT TSO GmbH is part of the Dutch system operator TenneT B.V. The company is responsible for about 10,700 kilometres of ultra-high voltage powerlines for efficient energy transmission over long distances. The network reaches from the Danish border to the Alps and with 140,000 km² it covers 40 percent of Germany.

The management of all 380 kV and 220 kV networks from TenneT is carried out with a newly developed PSI*control* system.

Transmission system operators have been presented with new challenges from new legal requirements and changes in environmental conditions. With the aim to optimally use the transmission capacity of the network at all times without risking network outages, system operators are switching to intelligent software solutions for optimal network management. TenneT is one of the strategic forerunners.

Based on PSI*control*, which is the centrepiece of the new solution (NLS08), TenneT and PSI have closely cooperated to develop functions allowing for optimal management and monitoring of the network, which has made the supply situation much more secure and easier to guarantee.

The noteworthy system architecture ensures a high level of redundancy. Parallel operation at the different sites offers additional security. The system also features exceptional time response.

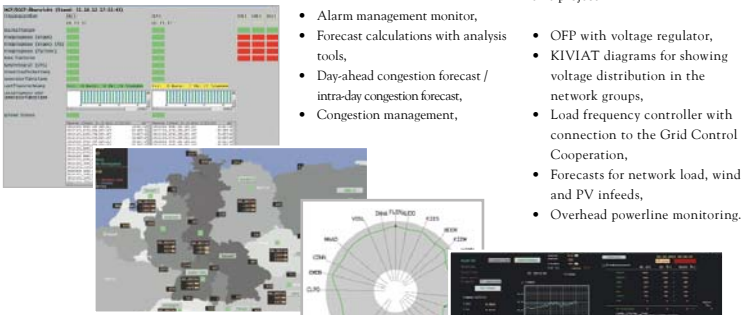
The new telecontrol technology is also equipped with comprehensive network protection calculations and functions for European energy exchange. In addition, TenneT trusts in PSI software and has implemented PSI*passage*-T and PSI*passage*-ACC for scheduling and controlling power management as well as unintentional deviation.

Please find below a selection of functions which were newly developed for this project:

- Alarm management monitor,
- Forecast calculations with analysis tools,
- Day-ahead congestion forecast / intra-day congestion forecast,
- Congestion management,
- Dynamic network connection and dynamic network group reduction,
- Intelligent solution for operational security.

The following functions were expanded and further developed for this project:

- OFP with voltage regulator,
- KIVIAT diagrams for showing voltage distribution in the network groups,
- Load frequency controller with connection to the Grid Control Cooperation,
- Forecasts for network load, wind and PV infeeds,
- Overhead powerline monitoring.



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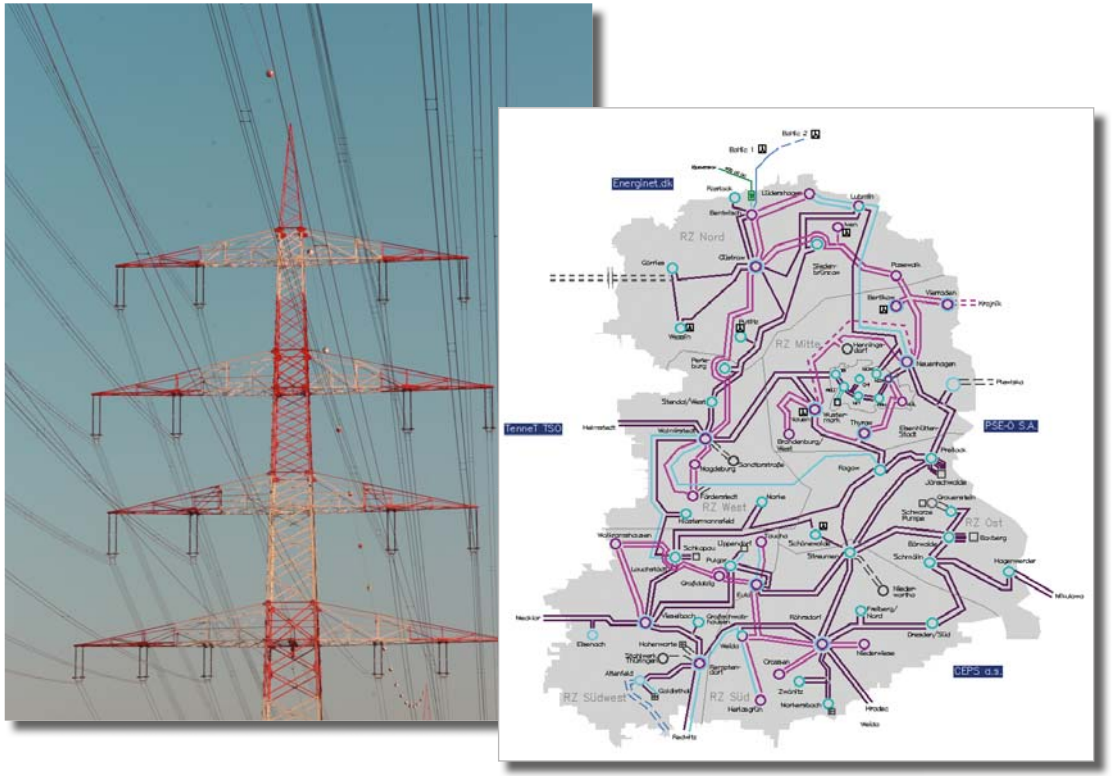
50Hertz Transmission - Network calculations for the operations of the 380/220 kV transmission networks

50Hertz Transmission is responsible for the operation, maintenance, planning and expansion of the 380/220 kV transmission network in Northern and eastern Germany. The network stretches over a surface of 109,000 km² and has a length of approx. 9,750 km. Almost half of Germany's installed wind turbines feed into this network.

50Hertz Transmission GmbH awarded an order to PSI for the delivery of network calculation functions for the 380/220 kV transmission network in Northern and eastern Germany.

50Hertz Transmission GmbH is a significant player among transmission system operators and PSI is honoured to welcome 50Hertz Transmission GmbH as a customer.



FSK EES - MES North West in transmission networks in Russia

FSK (Federalnaja Setevnaja Kompanija/Federal Grid Company/FSK), with its headquarters in Moscow, is the system operator for the entire Russian transmission network and the largest listed electricity transmission company in Russia.

FSK operates 124,000 km of 220-750 kV transmission powerlines and 854 substations throughout 8 regions. MES North-West is responsible for the most important region, their electrical network connecting the energy systems of Russia, Belarus, Lithuania, Latvia, Estonia and Finland. These zones comprise 11 Russian Federation regions with a complete surface of almost 2,500,000 km² and a maximum load of about 20 GW.

PSI was entrusted with realising a network control solution for a modern control centre for MES North-West in September 2008.

As is traditional for Russian network control centres, the solution comprises functions for network monitoring (SCADA) as well as a row of new and modern EMS/DMS functions such as state estimation, load flow, short-circuit, optimal power flow, N-1 security analysis, monitoring and analysis of static stability, etc.

For the first time in a Russian energy system, all these functions are combined into one unified realtime SCADA/EMS/DMS system. North West personnel are now ready to tackle brand-new operational tasks within the transmission network:

- Control of permissible technological limits of network operations,
- Network simulation of planned changes in the network topology, also in the background,
- Telecontrol of switches, reactive power compensators and voltage regulators with verification of different interlock types (user defined, status, topology NPC)
- Calculation and monitoring of energy losses based on voltage classes,
- Optimisation of network operation by minimising network losses,
- Calculation and network protection analysis before planned maintenance and associated switching measures,
- Post-mortem analysis of technological faults.

GridLab GmbH

GridLab GmbH is a subsidiary of Eurogrid International CVBA. Their goal is to be the European training and research centre for system protection of electrical networks. For this it is especially important to define, describe and to standardise processes in training and system operations. This system is specifically designed to meet training needs characteristic of European networks.

GridLab GmbH contracted the delivery of an operator training system from PSI in 2012.

At UpGrid 2012 in Moscow, PSI and GridLab jointly presented the development of this operator training system as well as the comprehensive approach for minimising and overcoming crisis situations. This greatly impressed the preponderantly Russian system operators sparking great interest.

PSI now has a very valuable new customer in GridLab and continues to grow in this market segment.

DSO - Control technology for regional distribution networks

Distribution system operators are changing their priorities based on changes in energy policies. With the massive increase in decentralised energy generation (for example, wind farms, solar generation and biomass power plants) system operators are facing new challenges to guarantee secure energy supply.

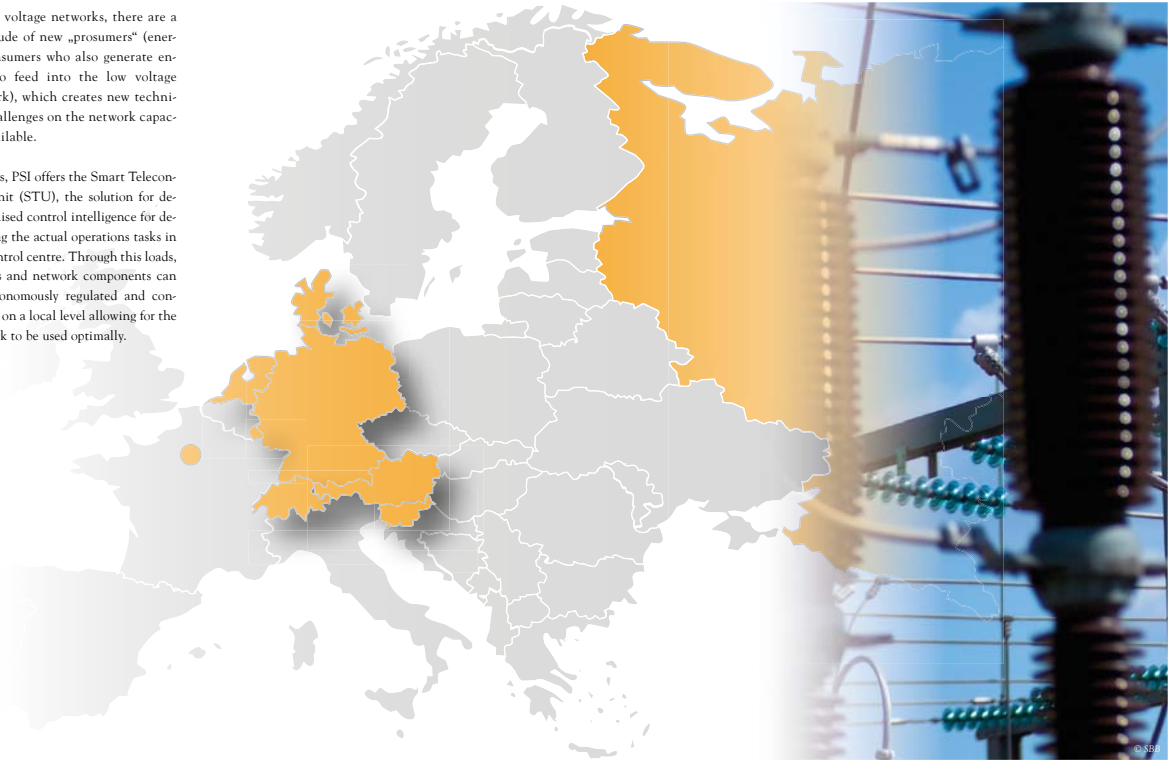
With PSI*control*, PSI offers a software solution which guarantees secure operation of high, medium and low voltage networks with numerous sophisticated applications. These include:

- Overhead powerline monitoring,
- Decentralised generation management,
- Congestion management,
- Network protection calculations also for the distribution network,
- Complete-model estimation,
- Voltage and reactive power controller as well as
- Disconnection point optimisation

The above smart grid functionalities offer great benefits and thus support system operators by providing the tools they need to operate electrical networks securely. Moreover, rules and regulations for connecting renewable energy sources have been considered in our solution for the German market.

In low voltage networks, there are a multitude of new „prosumers“ (energy consumers who also generate energy to feed into the low voltage network), which creates new technical challenges on the network capacity available.

For this, PSI offers the Smart Telecontrol Unit (STU), the solution for decentralised control intelligence for decreasing the actual operations tasks in the control centre. Through this loads, infeeds and network components can be autonomously regulated and controlled on a local level allowing for the network to be used optimally.



WESTNETZ

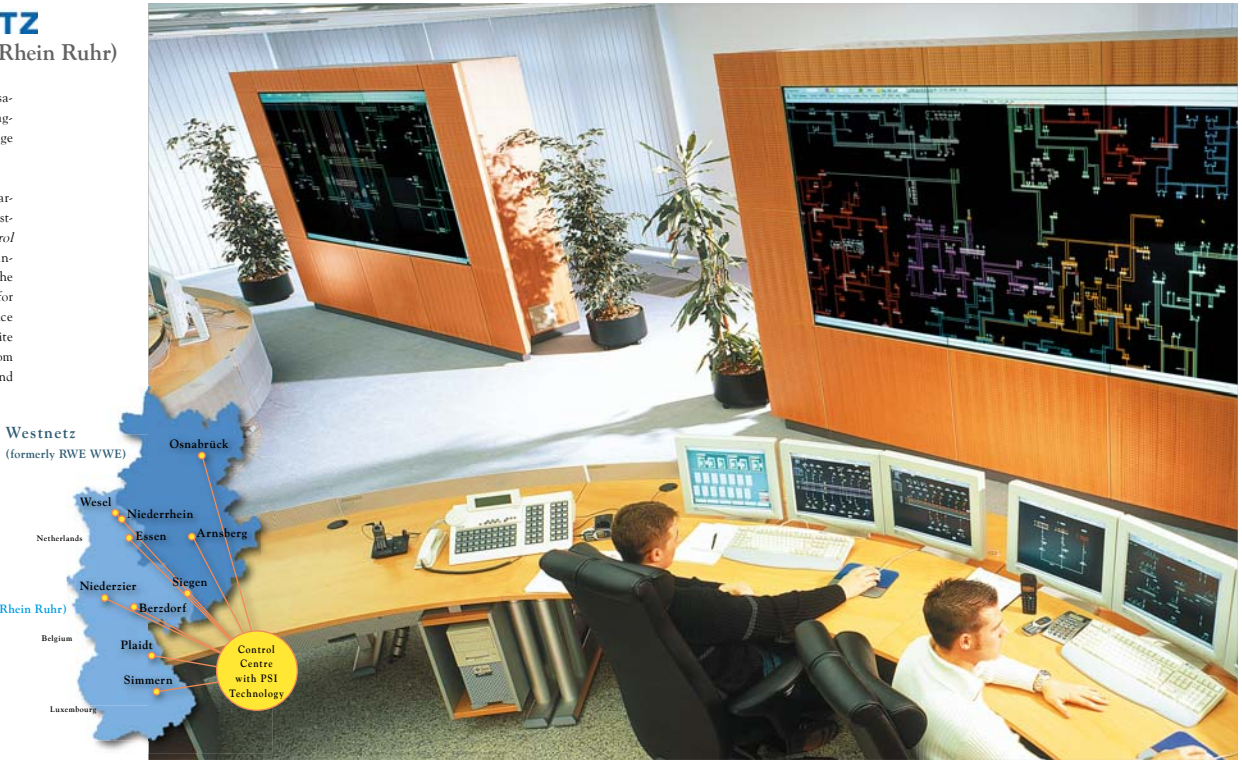
Control centre in Niederzier

WESTNETZ
(formerly RWE Rhein Ruhr)

PSI was entrusted with the realisation of all control centres for managing the high and medium voltage networks of Westnetz.

For effective support of fault clearance and crisis management, Westnetz decided to expand PSI*control* with PSI*command*. In order to increase efficiency even further, the CommBox especially designed for PSI*command* was mounted in service vehicles. This unit enables on-site personnel to send data directly from the vehicle to the control centre and complete any given task.

The systems of Westnetz are presently receiving an upgrade to concentrate the system to 3 control centres only.



WESTNETZ

110 kV control room in Arnsberg

WESTNETZ
(formerly RWE Westfalen-Weser-Ems)

The network of Westnetz (formerly RWE Westfalen-Weser-Ems) was previously operated by three separated PSI control systems which have been combined and operated by one harmonised control system since December 2010 now. The new system has distributed sites located in Arnsberg and Osnabrück.

The 110/30 kV network is managed in Arnsberg, the distribution network from both network control centres in Arnsberg and Osnabrück.

In addition to the functional range of the legacy system, the new system was equipped with new network management functionalities, such as geo-referenced network displays and fault analysis. In particular, PSI also implemented all requirements of the BDEW whitepaper for secure control and telecommunication systems in the system.

Along with PSI*control*, Westnetz also uses PSI*command* for accepting and processing faults.

WESTNETZ

Distribution control room in Arnsberg

WESTNETZ
(formerly RWE Westfalen-Weser-Ems)

WESTNETZ

Distribution control room in Osnabrück

WESTNETZ
(formerly RWE Westfalen-Weser-Ems)

Netze BW GmbH - 110 kV control room

Netze BW

The network control centre of Netze BW GmbH is equipped for efficient operation of

- the high-voltage network and
- the distribution network

with PSI*control* technology.

The flexibility of PSI*control* allows for stepwise concentration of network management.

For emergency and fault clearance management, Netze BW GmbH also entrusted PSI and implemented functionalities from PSI*command*.

Some duties of the control centre in keywords:

- To control and monitor the high-voltage network,
- To ensure network protection,
- To plan and complete switching operations for new installation, reinstallation and maintenance measures,
- To detect, isolate and correct faults,
- To deliver network operation services.

© Netze BW GmbH

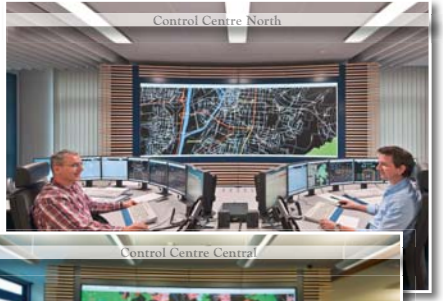
EnBW - Control centres North, Central and South

Netze BW GmbH operates the 30, 20 and 10 kV distribution networks in their northern, central and southern control centres.

The central network control system is found at the Esslingen site and is responsible for the central Neckar/Stuttgart region. The northern control centre in Heilbronn and the southern control centre in Ravensburg are connected to the network control system with remote workplaces. They operate the distribution networks in the Baden-Franconia and Lake Constance-Upper Swabia regions.

The main duties of all 3 control centres are:

- To control and monitor the distribution networks
- To ensure network protection
- To plan and complete switching operations for new installation, reinstallation and maintenance measures
- To detect, isolate and remove faults
- To deliver network operation services
- To log calls about faults



© Netze BW

EnBW Award

EnBW is a leading electricity company in Germany. Many orders, the value of which amounts to billions, were and will be awarded to external suppliers by EnBW. EnBW gave the EnBW supplier awards in 2008 to partner companies and suppliers for excellence and quality of service. With these awards, outstanding services in 2008 were recognised.

At the awards ceremony, PSI won second place in the IT category for the delivered control system.

This high recognition is an additional motivation for PSI to implement all projects awarded to us in close cooperation with our customers ensuring greatest possible satisfaction on both sides. A successful partnership means mutual success.

Control systems for managing large networks are very complex. Such large projects can only be successfully completed with close and good cooperation between the customer and the supplier.

We value the award from EnBW as recognition of our project colleagues from EnBW. Without their competence and engagement, this project would not have been such an enormous success.

The E.ON projects - Bayernwerk AG

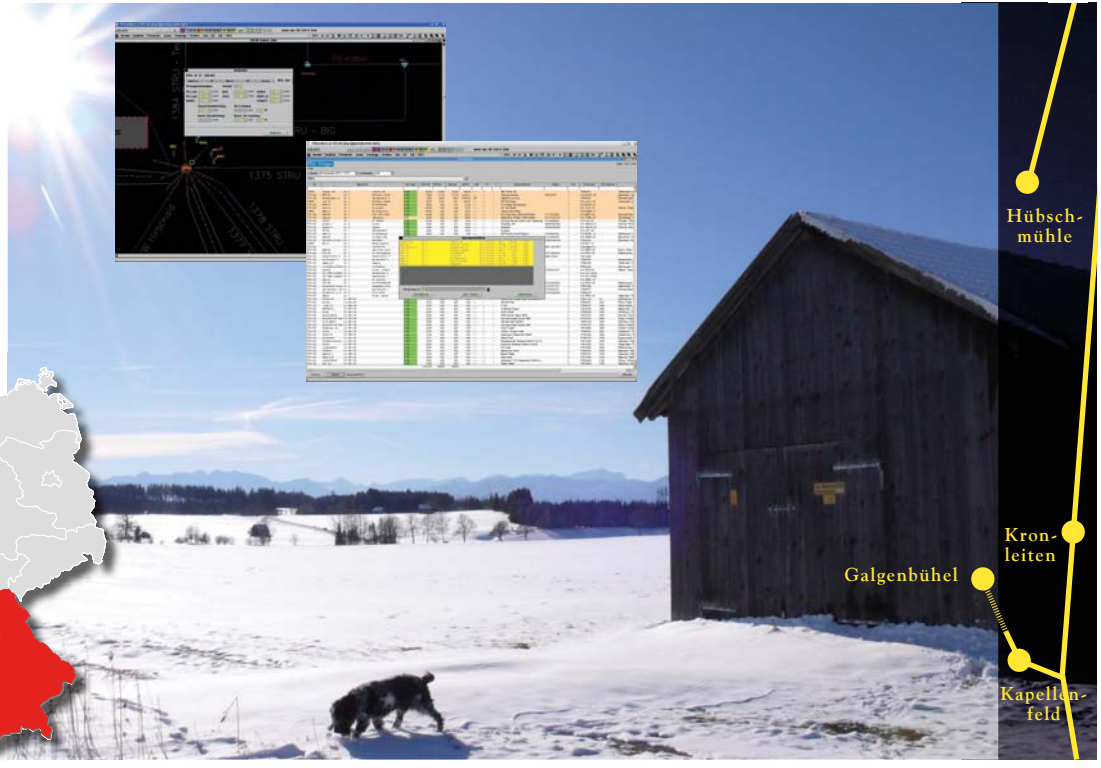
bayernwerk

All distribution management networks as well as the gas network from Bayernwerk AG are operated with a PSI*control* system.

The system architecture used allows the control system to be operated at one main control centre and, in case of emergencies, from a backup site.

The system is redundantly setup at each site. Parallel operation allows for an increased raise in availability.

Functionalities for managing decentralised infeeds allow for requirements based on national and international energy policies to be efficiently fulfilled.



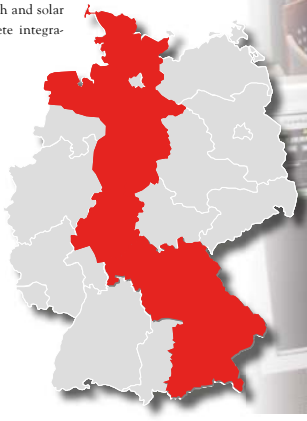
The E.ON projects - NL110 control system

E.ON Netz operates its 110 kV network with the NL110 control system from PSI. With a powerline length of 22,000 km and approx. 900 substations in an area of about 140,000 km², this is the largest network controlled by PSI*control* which stretches from the border with Denmark in the north to the southern border with Austria.

Functionalities such as the EisMan controller to control the network integration of renewable energy (for example, wind in the north and solar in the south), the complete integration of network protection calculation in connection with powerline monitoring as well as function components such as automatic ground fault compensation and load monitoring highlight some noteworthy characteristics.

Along with these, the system has a dynamically optimal reaction-behaviour thanks to its system architecture.

The process connection is made with info nodes which are completely redundant at both control system sites. Various telecontrol protocols are used based on IEC 61870-5-104 at the info node sites and normalised when transmitted to the control centres.



© E.ON Netz

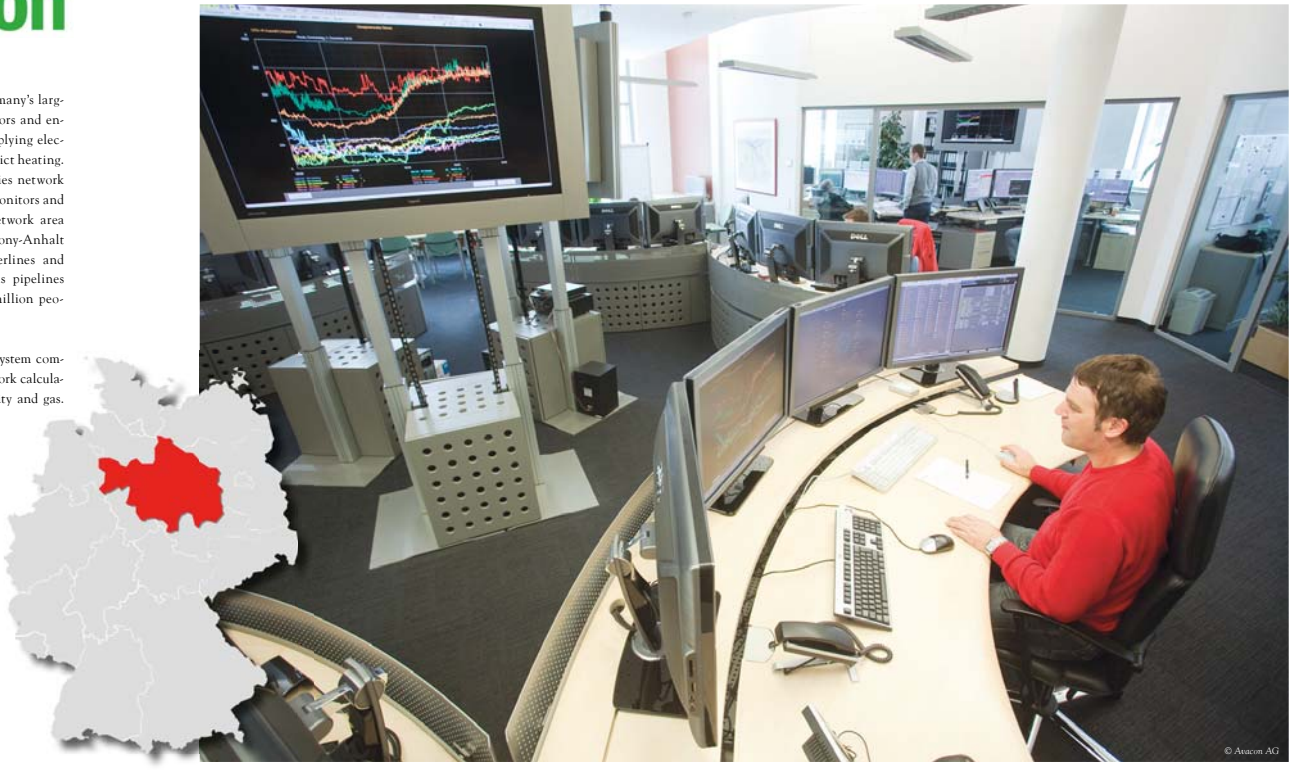
© E.ON Netz

The E.ON projects - Avacon AG

avacon

Avacon AG is one of Germany's largest regional system operators and energy service providers supplying electricity, gas, water and district heating. The new combined energies network control system from PSI monitors and controls a 22,000 km² network area in Lower Saxony and Saxony-Anhalt with 54,000 km of powerlines and 20,000 km of natural gas pipelines supplying energy to 2.2 million people.

The multi-client capable system comprises comprehensive network calculation functions for electricity and gas. For special gas functionalities, PSI*control* V7 from PSI's GO business division was integrated into the control system.



© Avacon AG

The E.ON projects - EnergieNetz Mitte

EnergieNetz Mitte

Ein Unternehmen der EAM Gruppe

EnergieNetz Mitte GmbH has been using a PSI control system for operating their high and medium voltage networks for many years. With the upgrade to a new generation of PSI*control*, management for the gas network was integrated into the control system.

Central network management occurs at both sites in Kassel and Baunatal. As the full range of network operations can be managed at both control centres, complete redundancy is guaranteed.

The control system contains functions for fault analysis, ground fault calculations, network calculations, FNN outage statistics and a georeferenced display of the technological network with display of standard map information and orthophotos.

© E.ON Mitte

The E.ON projects - TEN GmbH

Thüringer Energienetze

The electricity networks (110 kV and medium voltage) as well as the gas network from TEN Thüringer Energienetze GmbH are managed from a central network control centre in Erfurt.

PSI*control* allows for operations management at two sites. To guarantee that there is complete redundancy for the Thüringer Energienetze networks, a standby control centre was set up which can take over the complete monitoring and management of the networks.

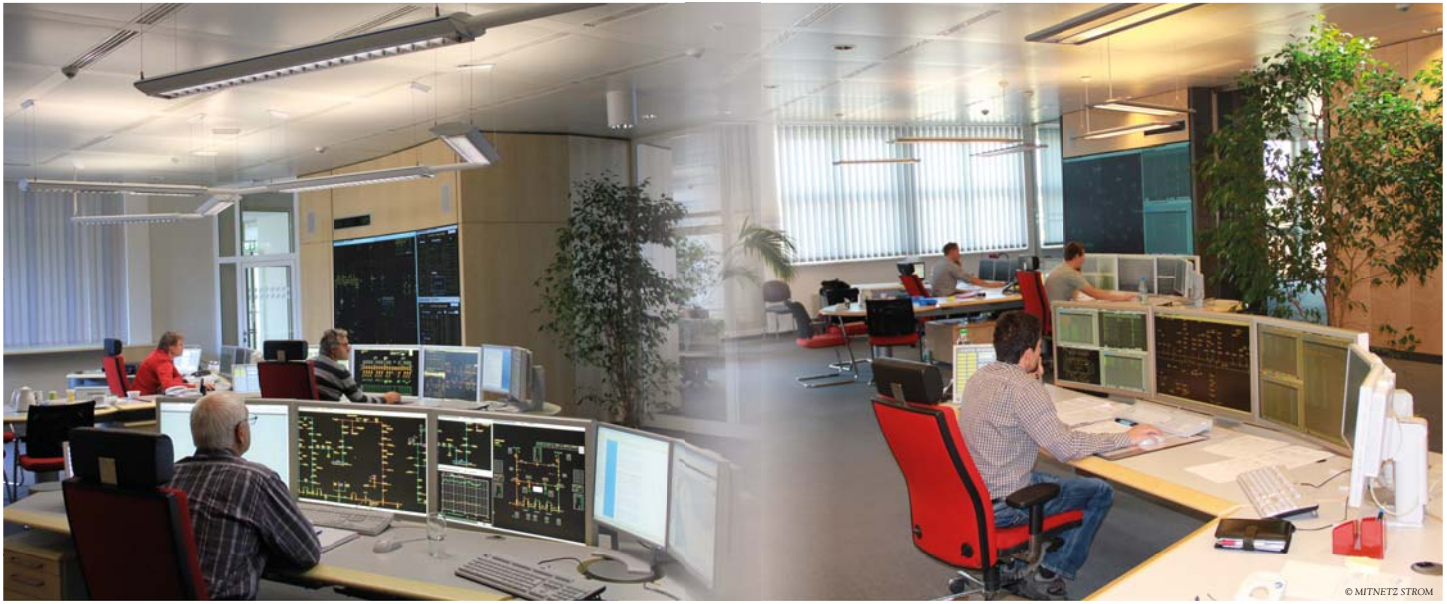
MITNETZ STROM - Control centre in Taucha

For the management of the 110 kV and medium voltage networks of MITNETZ STROM (formerly EnviaM), a PSI*control* system was installed. Network management as well as control systems are centralised at the Taucha location.

In order to guarantee complete redundancy, a standby control centre was set up which works in parallel to the control centre in Taucha and can assume monitoring and control duties in case of an emergency.

As an expansion to PSI*control*, MITNETZ STROM decided for PSI*command* for the areas of fault clearance and maintenance management. With PSI*command*, on-site personnel can be supported in the best possible way.

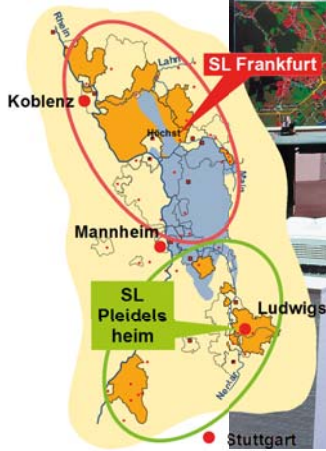
All maintenance and fault clearance measures are processed efficiently. The flexible use of staff members is optimised with Qualicision®, a product from PSI's subsidiary F/L/S.



© MITNETZ STROM

SYNA - Control centre in Frankfurt

SYNA GmbH operates two coupled PSI control systems with locations in Frankfurt and Pleidelsheim. With these multiply redundant systems, the combined energies control rooms monitor and control the medium and high voltage networks as well as gas, heating and production stations in the respective areas of responsibility.



LEW Verteilnetz GmbH (LVN)

Control centre in Augsburg

LEW Verteilnetz GmbH (LVN) is a regional distribution system operator in Southwest Bavaria. It operates and monitors its distribution network with 7,000 km of powerlines as well as its 110 kV network with PSI*control*.

The System ordered at the end of 2003 replaced the existing system after successful trial operation in 2005.

Later on, many expansions such as monitoring and management of decentralised infeeds (EEG), lightning localisation and orthophotos have made it possible to operate the entire network region even more efficiently.

ELE Verteilnetz GmbH (EVNG)

control centre in Gladbeck

The entire 110 kV and medium voltage electricity network as well as the gas network are controlled and monitored with PSI*control*.

For fault clearance and maintenance, a complete workflow from task planning to documentation is made possible with PSI*command* which works with PSI*control* integrally. Processing is supported by using mobile devices (vehicle-mounted CommBox, PDA, laptop).

Within PSI*command*, an additional GIS interface developed by PSI for ELE is used to transmit equipment data and task and outage reports, respectively.

According to a study of ELE Verteilnetz GmbH, the availability of the distribution network of Emscher-Lippe-Landes is above German and European averages.

(Source: http://www.ele-verteilnetz.de/Dokumente/Presse/2011_06_17/PI_2011_06_17.pdf)

AllgäuNetz and AÜW (Allgäuer Überlandwerk)

AllgäuNetz and their service provider AÜW have entrusted PSI with providing control systems twice. The PSI control system from 1996/97 was replaced by a new control system based on current PSI*control* technology.

With the renewal of the control system, expansions were integrated for geo-referenced network display with activation of orthophotos, FNN outage statistic functions, fault analysis functions and network calculation functions.

Against the background of many decentralised infeeds (for example, photovoltaic), the network calculation functions are indispensable.

The high and medium voltage networks are being monitored with the control system; furthermore, hydro-electric power plants and other power plants are being controlled.

Hyro-electric plant from AÜW (© AÜW)

Maintenance measures (© AÜW)

Pfalzwerke - Control centre in Mutterstadt

PFALZWERKE

In the control centre of Pfalzwerke, PSI*control* is used to manage the 220 kV, 110 kV and 20 kV networks.

The network comprises:

- A surface of approx. 6,000 km²
- Powerline length of 15,450 km
- 57 substations
- 4,200 transformer substations

SEAS-NVE - Control centre in Haslev

seas nve

The 132 kV, 50 kV and 10 kV electricity networks of SEAS-NVE, Denmark are monitored using PSI*control* at locations in Haslev and on the island of Zealand. Further regional office workplaces and other sites are connected to the control system, which is where outage requests are planned.

One of many functions is the interface to the G/Tech GIS for input of device data and geographic information of the distribution network.

The network region stretches between the islands of Zealand, Lolland, Falster and Møn.

Control centre in Haslev

© SEAS-NVE

The control centre monitors and controls

- 27 132 kV transformer substations with a total of 900 km of powerlines
- 117 50 kV transformer substations with a total of 1,100 km of powerlines
- 10,200 10/0,4 kV distribution substations with a total cable length of 9,200 km
- 1,000 wind turbines with a generating capacity of 700 MW

Enexis - Control centres in Weert and Zwolle

In 2009, the Dutch distribution system operator ENEXIS decided to replace both existing systems with a PSI*control* system. The scalability offered and the modularity of the system were decisive for ENEXIS in providing optimal operations in the future. The distribution management network is to be further automated with PSI*control* which will minimise the duration of fault situations in the network.

At each site, a separate supply network will be operated. Both networks will be operated in a collective system.

Both sites are connected to the overlapping system operator with self-contained redundant TASE.2 connections.

All schematic network diagrams on the distribution management level as well as geographic displays of the network will be cyclically imported from GIS. Furthermore, jobs created in the GIS will be imported into the control system and verified. This will allow for an operational planning mode to be implemented within PSI*control* in the future.

GIS data of the distribution management network comprise:

- About 600 diagrams and
- About 50,000 distribution substations.

ENEXIS is the largest Dutch distribution network operator supplying one third of the Netherlands with energy.

The company is responsible for installation, maintenance, monitoring and controlling of its network.

Control centre in Weert

Control centre in Zwolle

netz BURGENLAND

A company of the Energie Burgenland AG group

Since March 2011, the high and medium voltage networks of Netz Burgenland in Austria have been managed and monitored with a PSI control system from a central network control centre in Eisenstadt. A back-up control centre has been installed in Oberwart.

Network calculations are of great importance with respect to the many decentralised infeeds (e.g. wind power). Along with the higher functions for network applications in high voltage and distribution systems, fault analysis and switching operation support, a special feature is the coupling to the NEPLAN offline planning network calculation program.

The geo-referenced network display was technologically upgraded by displaying orthophotos and actual lightning strikes which are captured and fed into the system from the ALDIS lightning detection system.

In addition to the control system, Netz Burgenland has implemented local operational units based on PSI*control* in some of their substations to allow for local control of stations when necessary.

© netz BURGENLAND

ErDF - Control centre in Paris

ÉLECTRICITÉ RÉSEAU DISTRIBUTION FRANCE

For the first time, the French energy supplier ErDF awarded a contract to PSI to deliver a network control system. The distribution management system of the city of Paris is monitored and controlled based on PSI*control*. Crucial to the decision for ErDF were the specific technical requirements of the Parisian distribution management network which were best covered by the PSI solution.

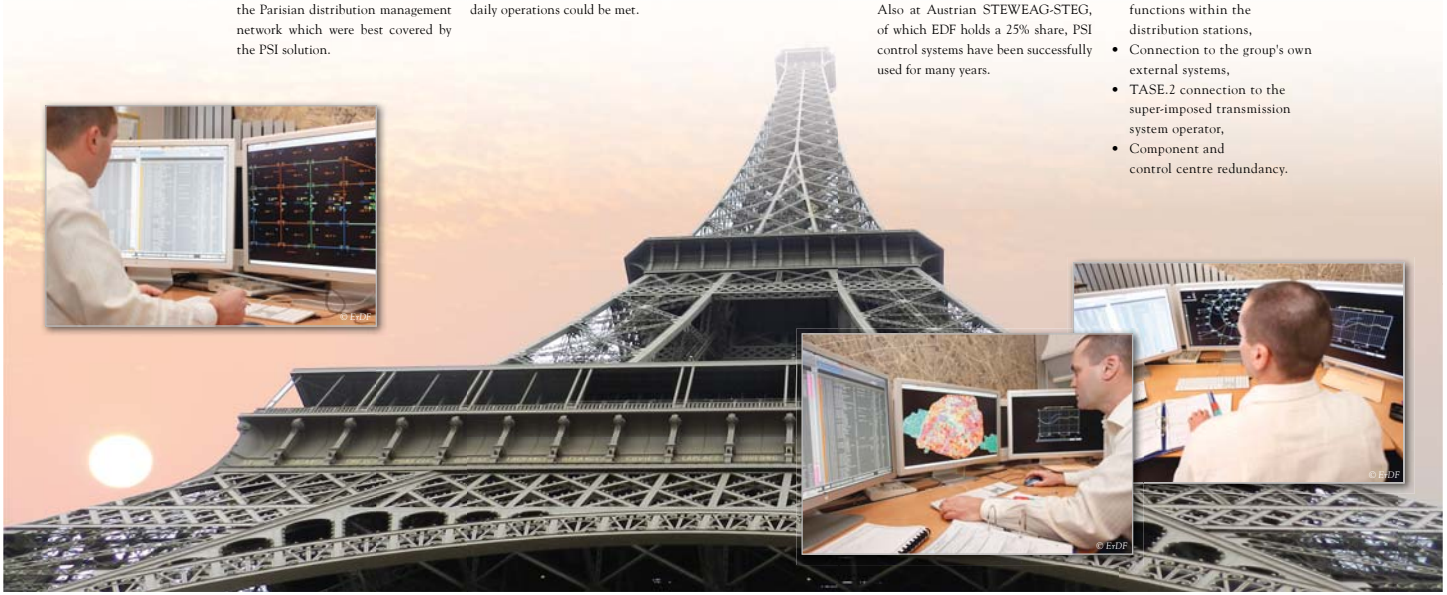
For the existing, technologically difficult to model ring-network topology of the Parisian city network, ErDF searched for a network control system with the highest possible level of flexibility to reach these requirements. With PSI*control*, these requirements and also many other complex tasks for daily operations could be met.

The EDF group is an integrated energy corporation covering all aspects of electricity supply. With over 40 million customers, EDF is a market leader in the European energy economy. Outside of the French market, EDF is represented in Great Britain and Italy.

Also at Austrian STEWEAG-STEG, of which EDF holds a 25% share, PSI control systems have been successfully used for many years.

Some important project components are:

- X.25 network,
- Dispatcher Training Simulator (DTS),
- Ring structure of the distribution management network,
- Simulation of automatic functions within the distribution stations,
- Connection to the group's own external systems,
- TASE.2 connection to the super-imposed transmission system operator,
- Component and control centre redundancy.



CREOS - Control centre in Luxembourg

Creos Luxembourg S.A. presently operates two electricity control systems from PSI AG at its sites in Heisdorf (previously Cegedel) and bd F.D. Roosevelt (previously Ville de Luxembourg). Both are equipped with backup control rooms for complete redundancy.

Moreover, Creos monitors and manages the gas network for the city of Luxembourg as well as the SOTEG gas transmission network.

In 2013, the replacement of both electricity control systems with a new collective combined energies control system from PSI will be completed in which gas functions are also integrated. Data acquisition will be carried out automatically from the named systems into the new collective PSI*control* system.

Along with PSI*control*, Creos also uses PSI*xchange* as portal software (e.g. as a web portal, communication server, reporting system) as well as PSI*passage* for schedule management for electricity and gas.

Further to the classic SCADA functions, the Creos control system contains the following functionalities:

- Connection to another regional centre using remote workplaces and office workplaces, respectively,
- Online network calculation functions (electricity and gas), instationary gas network calculations, tracking of calorific values,
- Connection to the Smallworld GIS for import of network diagrams (geographic and schematic for electricity and gas),
- Expanded functions including display and analysis of weather data (lightning),
- Support for switching operations (switching programs, switching sequences, outage requests),
- Managing external networks (clients).

BKW FMB Energie AG

BKW

In December 2007, PSI received the contract to replace the existing network control components for the 132 kV network with PSI*control* whereby the RTU process interface was to remain unchanged to the greatest possible extent. In August 2009, the new LSB system came into operation. In order to guarantee complete redundancy, an emergency control centre with complete functionality was set up at a second site.

Noteworthy components are:

- SCADA system for the distribution network and hydro power plants,
- Post-mortem analysis,
- Multinet technology, Multi-client administration,
- Geo-referenced network display,
- External system interface.

In a second step, BKW FMB Energie AG made it a strategic goal to combine both PSI*control* systems: LSM (distribution and production) and LSB (interregional distribution network). The operation started in January 2013, system handover is planned for January 2015.

© BKW

Elektro Ljubljana d.d. - Control centre in the capital of Slovenia

Elektro Ljubljana d.d. operates the largest electricity network in the Republic of Slovenia. The infrastructure covers 6,166 km² of the central part of Slovenia (30.4% of the complete area of the republic) and covers 36% of all Slovenian house holds.

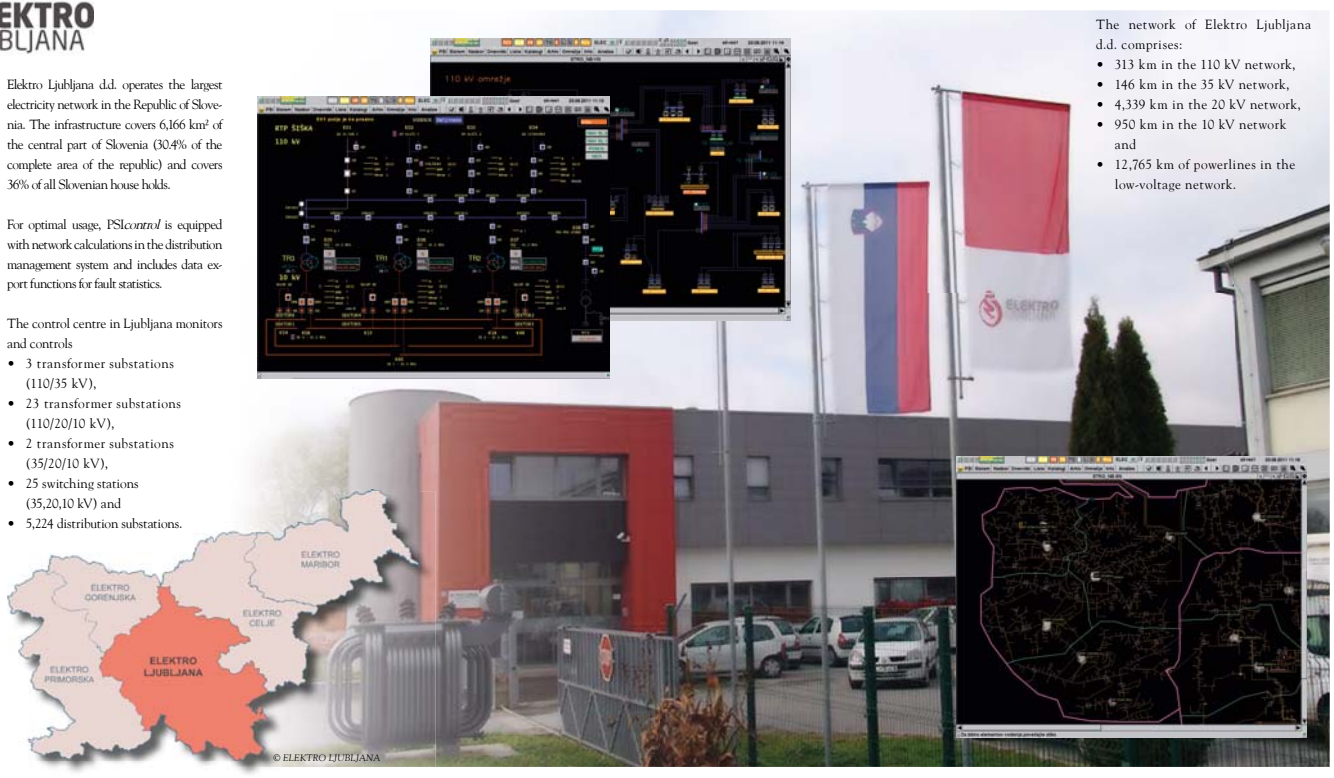
For optimal usage, PSI*control* is equipped with network calculations in the distribution management system and includes data export functions for fault statistics.

The control centre in Ljubljana monitors and controls

- 3 transformer substations (110/35 kV),
- 23 transformer substations (110/20/10 kV),
- 2 transformer substations (35/20/10 kV),
- 25 switching stations (35,20,10 kV) and
- 5,224 distribution substations.

The network of Elektro Ljubljana d.d. comprises:

- 313 km in the 110 kV network,
- 146 km in the 35 kV network,
- 4,339 km in the 20 kV network,
- 950 km in the 10 kV network and
- 12,765 km of powerlines in the low-voltage network.



Elektro Celje - Control centre in the economic centre of Slovenia

Elektro Celje, d.d.

Elektro Celje, d.d. is one of five system operators in the Republic of Slovenia.

For reasons of optimisation, PSI*control* was equipped with network calculations for distribution networks and has a data export function for FNN outage statistics.

In addition, EMS functions (load forecasts) and SPI (SCADA programming interface) were integrated to provide Elektro Celje d.d. with the capability to further expand the control system in the future independently.

The control centre in Celje monitors and controls the following using PSI*control*:

- 18 transformer substations,
- 13 switching stations and
- 3,337 distribution substations.

The Elektro Celje network comprises:

- 101 km of powerlines for the 110kV network,
- 2,784 km of powerlines for the 35, 20 and 10kV networks.
- 657 km of cables for the 20 and 10 kV networks and
- 12,765 km of powerlines in the low-voltage network.

© ELEKTRO Celje, d.d.

MRSK - Distribution networks in Russia

MRSK (Mezhregionalnaja Setevaja Kompanija / interregional distribution grid companies (IDGC) / MRSK), with headquarters in Moscow and 14 subsidiaries in the regions, are the electricity distribution companies in Russia.

In 2008, an order was placed for a new control technology solution for a modern control centre. By today, 15 installations by MRSK subsidiaries are in operation.

For MRSK this includes

- Central and Volga region,
- Volga,
- South,
- Tjumenenergo,
- Ural.

During the first implementation steps, the basic functions for network monitoring and network control were ordered and realised. After the basic functions had been successfully implemented and entrusted to operational personnel, the next stages for higher functionalities (e.g. network applications, fault analysis, GEO information, workforce management) were started.

PSI AG is in close dialog with MRSK customers in order to collect specific Russian requirements for distribution network operation and to create a special Russian release. Our contact with end-customers is important to us. Above all, we want to ensure quality when developing projects with our local partners and achieve the highest possible degree of satisfaction.

MRSK Central and Volga Regions:

- Vladimirenergo
- Nizhnovenergo
- Ryazanenergo
- Tulaenergo
- Ivenergo

MRSK Volga:

- Samarskie Distribution Networks
- Ulyanowskie Distribution Networks
- Mordovenergo
- Tschuvaschenerg

MRSK South:

- Volgogradenergo

Tyumenenergo:

- Nefteyuganskie Electricity Networks
- Noyabrskie Electricity Networks
- Kogalymskie Electricity Networks
- Surgutskie Electricity Networks

MRSK Ural:

- Sverdlovenergo

BaschRES Distribution Networks
(other customers - outside of MRSK-Holding)

TNB - Kuala Lumpur, Malaysia

With a value of more than 65 million Ringgit (approx. 16 million Euros), publicly traded Tenaga Nasional Berhad (TNB) is the largest electricity provider in Malaysia and has 6.8 million customers on the Malaysian peninsula.

In 2001 a request for proposal for distribution network automation and a new control system for the metro region was published. The project was awarded to inControl Tech (now, PSI INCONTROL SDN. BHD), Topank and PSI.

IN 2006, TNB invited tenders for another three control systems. These were also won by PSI and inControl Tech.

With these control systems, the entire network of the Malaysian peninsula is monitored and controlled by PSI*control*.

The complete PSI scope of delivery comprises:

- PSI*control,*
- A robust SCADA system,
- Distribution network functions,
- Dispatcher Training Simulator,
- 3 control centres as well as
- 2 standby control centres.

All control centres communicate via TNB WAN. No changes were necessary for the interfaces of existing and new RTUs.
The following protocols are used:

- Harris 6000,
- WISP+,
- IEC 60870-5-101,
- IEC 60870-6 (TASE.2).

As the TNB network structure grows at an average rate of more than 7% per year, the system must include enough reserves in order to overcome the growing load and to guarantee continued expansion of the electricity network in the data model.

PEA - Bangkok, Thailand

Provincial Electricity Authority (PEA) is a state-owned company of the Kingdom of Thailand. PEA is first and foremost responsible for the generation, provision and distribution of electrical energy.

PEA's electricity network comprises 510,000 km² and covers every area of Thailand with the exception of Bangkok.

In order to improve the quality of life for the people, PEA has invested in modern technology for electricity generation and distribution. Simultaneously, decentralised control centres were planned to raise efficiency and guarantee reliable energy supply to Thai provinces.

PEA was impressed with PSI technology and PSI received the contract to realise control systems for 7 of 12 provinces with PSI*control*. From the end of 2012, all 7 control systems have been in trial operation.

PEA's most important requirements for the new control system are the following:

- SCADA:
  - Parallel use of rear-projection video walls from all workplaces,
  - Orthophotos,
  - Process emulator,
  - Automatic creation of switching sequences,
  - Post-mortem analysis,
  - Automatic load-shedding,
  - Outage management system (OMS),
- DMS functions:
  - 3-phase network calculations for transmission and distribution networks,
  - Load-flow calculation,
  - 3-phase short-circuit calculation,
  - Integrated Volt/VAR regulation,
  - Energy management system,
  - Detecting 1-phase cable breaks,
  - Fault analysis with automatic fault isolation and service restoration.
- Other requirements:
  - TASE.2 control centre connection,
  - Bilingual (Thai and English),
  - Cyber security based on the NERC standard,
  - Office connections with Java clients,
  - GIS import with automatic GEO picture generation.

© rtf79 / Pixelio

MEA - Bangkok, Thailand

Metropolitan Electricity Authority (MEA) is a distribution system operator for the Bangkok region with an area of 3,192 km² and 3.1 million customers with a growth rate of 2.7%. In 2011, the maximum need accounted for 7.8 GW. MEA distributes energy using 127 substations on 12 kV and 24 kV levels. 51,000 low-voltage transformers intersect with 1,565 outgoing feeders.

In order to raise network stability and functional capability, MEA decided to invest in a new control system in 2010. MEA was greatly impressed with PSI's concept and PSI was honoured to receive the contract. The PSI*control* system ordered will be operated at 2 main control centres and 2 of 18 regional control centres.

Along with many standard functions, noteworthy highlights are:

- Fault analysis with automatic fault isolation and service restoration,
- Automatic load-shedding,
- Outage management system,
- Automatic switching sequence creation,
- 3-phase network calculation,
- Data archiving and report generation with an interface to the PI system,
- GIS import with automatic GEO picture generation,
- Office connections with Java clients,
- Cyber security based on the NERC standard as well as
- Bilingual user interface (Thai and English).

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MEDC - Muscat, Oman

Muscat Electricity Distribution Co.

Muscat Electricity Distribution Company (MEDC) supplies customers in an area of 3,900 km² in the Muscat region, in and around the capital of the Sultanate of Oman. At the end of 2010, MEDC ordered a new SCADA system from PSI. The project will be completed by a consortium consisting of PSI, ONEIC (Oman National Engineering and Investment Company) and 3WNetworks.

Along with the actual SCADA system, the project comprises the upgrade and connection of 157 substations and 10 automatic reclosers as well as corresponding RTUs and telecontrol technology. Communication is effected using the IEC 60870-5-104 telecontrol protocol. All stations are connected using fibre-optic, VHF, GPRS and copper cables and a fibre-optic SDH backbone ring connected to the control system.

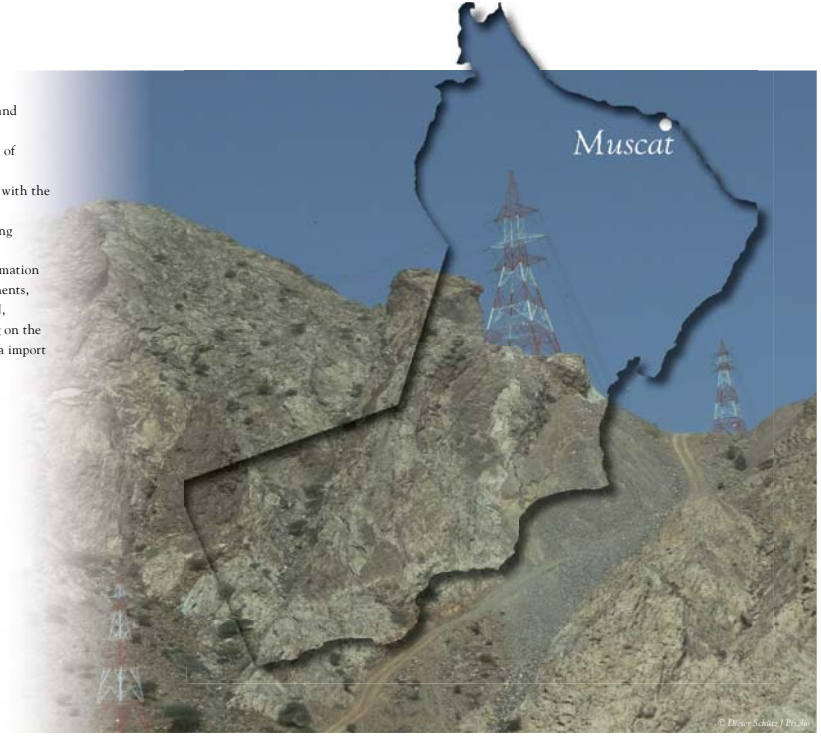
The project scope includes system design, engineering, implementation, installation, test, commissioning and training.

The SCADA master station is found in the main control centre which will be complimented by an emergency back-up control centre.

The system makes all schematic diagrams for the three-zone network available to control centre personnel. Included as well are diagrams for all telecontrol stations, station diagrams with one pole display for all stations and geographic overview diagrams.

The following functions are part of the project scope:

- All essential SCADA functions (monitoring and control),
- Dynamic assignment of authority and multiple protection levels for system access,
- Network topology analysis,
- Dynamic network colouring,
- Processing of realtime telegrams,
- Post-mortem analysis,
- Notebook functions,
- Job management,
- Protection interlocks,
- Automatic load-shedding and network restoration,
- Automatic predefined report generation and tabular export to Excel and PDF,
- Device statistics,
- ICCP communication and interoperability,
- Study mode and export of realtime database data,
- Functional cooperation with the existing GIS,
- Application programming interface (API),
- Monitoring of the information network and its components,
- Remote access via VPN,
- Data and picture editing on the system as well as via data import from the GIS.



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PSI*control*-Multinet

Control technology for combined energies

PSI*control*-Multinet was developed for controlling different supply networks with one control system.

The concentration of control technology offers great benefits in reducing initial investments and running costs.

PSI*control*-Multinet allows one physical control system to operate multiple logical control systems in parallel. In multinet technology, the software system works with separate data model worlds.

This allows to chose between commodity-integrating network control or operations using individual networks.

SWU

AVG Aschaffenburger Versorgungs GmbH

Stadtwerke Essen AG

SW//M

REWAG

NETRION

Wien Energie Stromnetz

STAWAG

Energieversorgung Offenbach AG

Netzgesellschaft Düsseldorf mbH

RheinEnergie

EVNG

Stadtwerke Duisburg Netzgesellschaft mbH

NetzDienste RheinMain

SWK

N-ERGIE

KVNetz KEVAG Verteilnetz GmbH

© Netzgesellschaft Düsseldorf mbH

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Enercity - Control centre in Hanover

enercity
positive energie

Since 2004, our PSI*control* system at Enercity has been in operation to monitor and control all high and medium voltage substations of Hanover.

Especially noteworthy are the "station heads" which allow switching operations to be undertaken locally in the substations using the control system. These station heads contain the information of the complete network.

In case of a connection fault of the substations to the network control centre, the networks can be autonomously operated using the station heads.

N-ERGIE - Control centre in Nuremberg

N-ERGIE

In the combined energies control centre of N-ERGIE, PSI*control* is used to control the 110 kV and 20 kV electricity networks as well as the gas, water and district heating networks for Nuremberg and large parts of Franconia.

The electricity network of N-ERGIE Netz GmbH has a complete length of over 26,000 km. The gas network covers a pipe length of 3,200 km, the drinking water network comprises 2,300 km in the city of Nuremberg and the district heating network consists of 375 km.

Quantity structure (approx.):

- 55 110 kV substations
- 350 20 kV substations
- 7,500 secondary substations (electricity)
- 350 gas stations
- 8 water stations
- 42 district heating stations
- 630,000 domestic service connections (electricity)
- 75,000 domestic service connections (gas)
- 80,000 domestic service connections (water)
- 5,000 domestic service connections (district heating)

Netzgesellschaft Düsseldorf mbH

Netzgesellschaft Düsseldorf mbH

Netzgesellschaft Düsseldorf mbH manages all of their supply networks with PSI*control*.

To support fault management, the control system was equipped with workforce management functions from PSI*command*.

Also, Netzgesellschaft Düsseldorf mbH uses PSI software for system usage management and energy data management. They have decided for PSI*passage*-D.

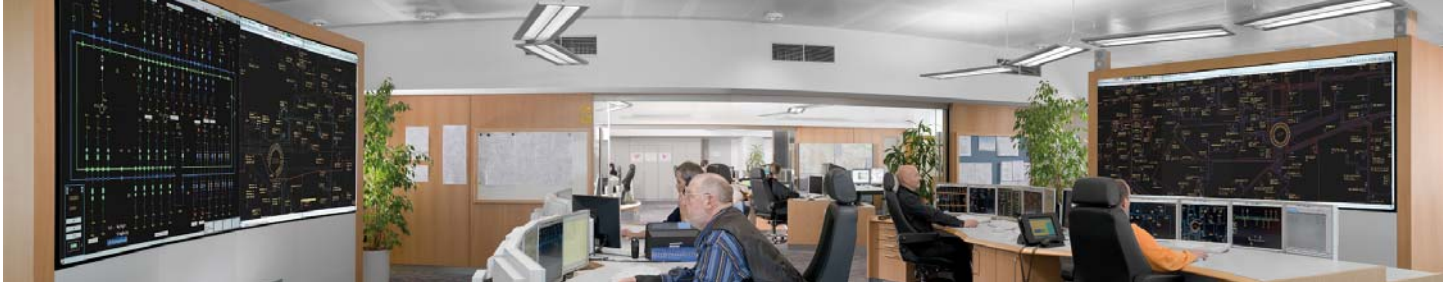
RheinEnergie - Combined energies control centre in Cologne

Rhein Energie AG operates their third generation control system based on PSI*control*.

The picture below shows the combined energies control centre of Rhein Energie AG, from which the energy and water networks are managed centrally.

In the top picture of the control centre, the workplaces for electricity network operations can be seen on the right, while those for pipe network operations can be seen in the middle.. In the background of the left half of the picture, the technical support service centre of Rhein Energie AG is shown.

Here, incoming fault indications are recorded with the integrated fault clearance system in PSI*command* and are then made available to network operations. Dispatching fault clearance tasks, their transmission to mobile devices of the engineers on site, task responses as well as monitoring the fault clearance process on all workplaces is carried out at one central point using functionalities of PSI*command*. For data exchange between on-site personnel and the combined energies control centre, our vehicle-mounted CommBox is used.



Stadtwerke München

The combined energies control system of Stadtwerke München is equipped with PSI*control* and was put into operation with the second generation system of PSI*control* in 2009. It monitors and controls electricity, gas, water, district heating, remote cooling and rail electrification.

Also for fault clearance management, Stadtwerke München decided for a PSI product. The powerful control system integrated functions of PSI*command* are used in the control centre as well as on the specifically developed CommBox to apply in the service vehicles.

REWAG Regensburger Energie- und Wasserversorgung AG & Co KG

Immer für Sie nah!

In the REWAG network control centre, the 20 kV network, 11 kV network, the gas, water and district heating networks for the Regensburg area are all controlled using PSI*control*.

REWAG is now operating their second-generation control system based on PSI*control*.

Stadtwerke Ulm/Neu-Ulm GmbH

SWU

In the control centre of SWU Energie GmbH, a subsidiary of Stadtwerke Ulm/Neu-Ulm, the 110 kVnetwork, 20 kV network, 10 kV network, low voltage network as well as the gas, water and district heating networks of the cities of Ulm and Neu-Ulm and the surrounding communities are operated using PSI*control*.

Also, SWU's own power plant is monitored by PSI*control* in the control centre.

SWU Energie GmbH operates their third-generation control system based on PSI*control*.

Stadtwerke Krefeld

As early as 1980, the cooperation between SWK and PSI began with a study for a new central combined energies control centre in Krefeld. Electricity, gas, water and district heating were integrated into one system in one control room.

In 2002, the second generation of the control system was ordered which comprised multi-client capability, energy regulation with RCS connection, rear-projection video walls in the control room and the display of geographic network diagrams.

The productive start of the third-generation PSI control system followed in 2012. New components include an operator training system, orthophotos and the PSI*xchange* data exchange platform.

© Stadtwerke Krefeld

NETRION GmbH

Combined energies control centre in Mannheim

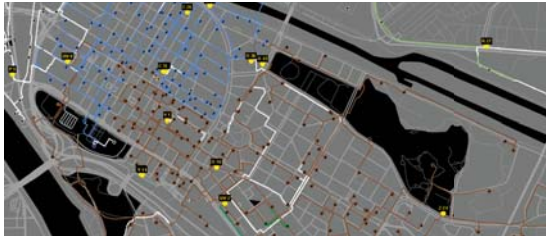
www.netrion.de

Netrion GmbH, a company of the MVV Energie Group and previously known as 24/7 Netze GmbH, is the collective network association of MVV Energie AG and Enerergieversorgung Offenbach AG with headquarters in Mannheim.

With the powerful combined energies control centre, Netrion has a network competence centre with which the company reliably controls and monitors the generation and distribution of electricity, gas, water and district heating.

The innovative PSI*control* system was developed and realised by PSI. In close cooperation with system operators, the system was tailored to the individual requirements of Netrion, who uses its combined energies control centre to provide services to industry and utilities. The staff members monitor and control networks, which are completely geographically separated from each other, from one location. Further tasks carried out are dispatching for economic network management as well as fault clearance management. All these are carried out using the PSI*command* software solution, which is fully integrated in the control system.

20 kV GEO plan



20 kV network diagram

KEVAG Verteilnetz GmbH (KVNetz)

Control centre in Koblenz

KVNetz
KEVAG Verteilnetz GmbH

KVNetz operates a distribution network, which comprises a medium and a low voltage network including substations for the city of Koblenz and its surrounding communities. In November 2012, PSI*control* replaced the existing network control system, which was also equipped with PSI software. In order to guarantee complete redundancy, a further control centre was set up for emergencies.

To ensure smooth and efficient daily operations, numerous functions were integrated including SCADA functions, network calculations, network fault processing, switching sequences, post-mortem analysis, geo-referencing, GIS data import (SICAD) as well as tools for creating various reports. To allow for remote control of electrical loads and switching tariffs, the control system was equipped with a ripple control system. It is used for controlling municipal lighting and switching tariffs.

In order to fulfil continuously increasing requirements on network operations and planning, PSI has jointly implemented the IMENDO X-PORT interface solution with Austrian IMENDO GmbH.

Here, all relevant network information is exported from the PSI*control* database and sent to the NEPLAN network planning tool through this interface.

In doing so, network planning always works with a current and verified realtime database in NEPLAN without the great effort and expense of manual data entry.

NRM - Control centre in Frankfurt

NetzDienste RheinMain

Mainova AG's electricity network as well as the electricity network of Stadtwerke Hanau are monitored and controlled by the NRM combined energies control system.

The control system features the following noteworthy technical characteristics:

- Operation of rear-projection video walls as tandem workplaces with an additional master workplace (see picture to the left) as well as
- Functions of the electricity decoupling system for continuous calculation of disconnector settings in cases of underfrequency as a function of balanced islands.

In addition, there are functions for managing the Mainova gas network as well as for managing gas transmission lines as a service for the gas union (pictured right).

Electricity control room

Gas control room

Stadtwerke Bonn

SWB is part of the Stadtwerke Bonn group operating as a regional supplier in the city of Bonn and the SWB Rhein-Sieg-Kreis area.

The electricity network is monitored and controlled around the clock using the PSI*control* system. Along with standard data from substations and switching yards, protection data and measured impedance values are transmitted to the network control centre. The control centre can also support on-site personnel with GIS data integrated from the provider Teleatlas.

STAWAG - Control centre in Aachen

In May 2011, the combined energies PSI*control* system in the STAWAG network control centre went into operation. All stations in the electricity, gas, water and district heating utilities as well as transfer sites from surrounding regions are monitored and controlled from here.

GIS data and land registry data from Aachen are imported for use in the control system for all four utilities. For pipe networks, special diagrams are generated automatically. Moreover, network application functions are implemented in all utilities.

Stadtwerke Duisburg Netzgesellschaft mbH

After initially using PSI*control* for the electricity network only, Stadtwerke Duisburg (Duisburg municipal utilities) decided to control their other networks with PSI software so that the electricity, gas, water and district heating networks are now operated together in a combined energies system with PSI*control*.

In 2011, PSI*command* was integrated into the control system in order to make clearing of gas faults more efficient. Now, PSI*command* is also being used for the other utilities.

In order to further decrease costs resulting from fault clearance management, service vehicles were equipped with the CommBox, which was especially designed for use with PSI*command*. With this, data can be sent to the control system while engineers are still on-site which allows for corresponding tasks to be documented and completed in better time.

Developed specifically for Stadtwerke Duisburg AG, the power plant regulation and optimisation functions are especially noteworthy. These have been in operation since 2011 and were equipped with tertiary power retrieval.

In addition, the control system is equipped with a ripple control system, post-mortem analysis and a Dispatcher Training Simulator, the latter supporting the continuous training of control centre personnel by simulating realistic scenarios.

Stadtwerke Essen

Stadtwerke Essen AG supplies the city of Essen with gas, electricity and water. As well, Stadtwerke Essen operates a trilogistic centre with Stadthafen Essen (Essen harbour) and is responsible for the maintenance and expansion of the waste water network in the city.

A central network control system is in operation for monitoring and controlling the gas, water and waste water networks of Stadtwerke Essen AG which is going to be replaced by the PSI*control* system after more than 20 years.

Technical requirements, functions and interfaces to the GIS were implemented in the PSI*command* system during the realisation phase. Another requirement of the project is the change of location of the control centre planned for 2013 which will affect the implementation phases of site acceptance testing and commissioning.

Wien Energie electricity network - The electricity supply in another European metropolis is ensured with a PSI system.

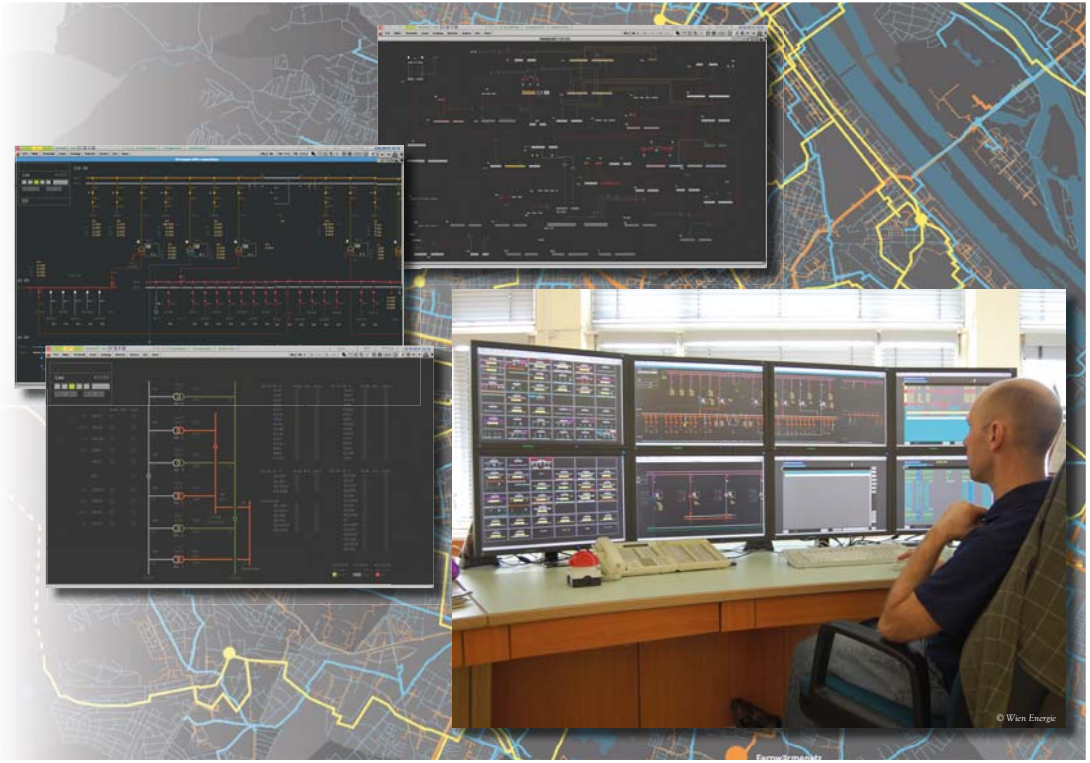
In 2010, PSI AG received an order for the delivery of a network control system for the high and medium voltage networks (380 kV, 110 kV, 20 kV, 10 kV) of the Austrian capital Vienna and surrounding communities in Lower Austria.

The system comprises the management of 45 substations and the DMS network with over 10,000 transformer substations and approx. 235,000 network connections. An emergency workplace for the load distributor was integrated in the system.

With the new control system and the connected expansions, comprehensive operation of the distribution network, control sites and the load distributor is possible.

The operation of substations is distributed between three independent control sites. The first control site is already in operation with the new control system.

In addition, the DMS network will be monitored with mobile workplaces.

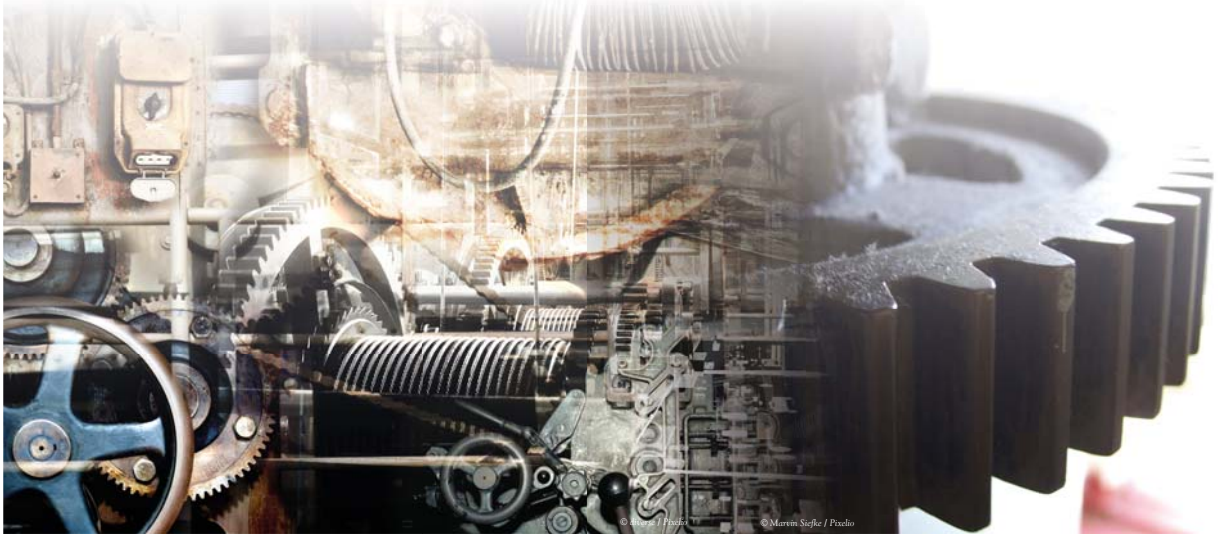


PSI*control* -
Providing control technology for Industrial networks

With the use of modern communication technology, today measurement variables are also available in industrial environments which allow the electricity networks of the company to be managed effectively. Outage times can be minimised by fast automatic analysis and even automatic switching operations, wherever necessary.

The change in energy policies creates a growing interest of industrial customers in energy management functions. Even in this subject area, PSI offers control technology functions to make a more cost-effective use of energy possible.

The "virtual power plant" component offers the possibility to partake in energy regulation markets by using pool modelling of energy- intensive industrial plants. Through this, positive and also negative tertiary power can also be marketed under efficient coordination with production planning.



Companies of the chemical industry in Germany

An important industrial network customer is a chemical company which primarily produces polymers.

Since 1998, PSI*control* controls and monitors their high, medium and low voltage networks with 300 RTUs and 20,000 data points, with a second-generation update having been installed in the meantime.

Operations are carried out using 6 workplaces which are divided between a control centre and a back office. They are connected to an alarm system for emergencies. Visualisation has been realised using cascadable rear-projection video walls.

The most important task for PSI*control* is to guarantee uninterrupted and secure production.

Based on PSI*control*

- SCADA functions and
- network application modules

as well as the following customer -specific functions were implemented:

- Extensive analysis functions,
- Specific topology analysis,
- Support for stand-alone operation,
- Control of motor ramp-up,
- Display of maintenance duties in chemical facilities,
- Usage of orthophotos.

BASF AG - 20 Years of network management with PSI*control*

Since more than two decades, BASF AG has operated and monitored their electrical network and various pipe networks with PSI control systems at their main location in Ludwigshafen.

BASF AG, founded in 1865, is even today one of the largest chemical groups in the world based on revenue and market capitalisation. The BASF location in Ludwigshafen is the largest continuous chemical site in the world.

For supplying the factory with electrical energy, a comprehensive electricity network has been constructed with voltage levels from 220 kV to 6 kV. This network is coupled with Amprion's 220 kV transmission network. The supply of critical production units in stand-alone mode in case of faults in the Amprion network is guaranteed with the company's own generation units.

These units also generate steam needed for production purposes in multiple steam levels.

The first contract for an integrated control system for operating this network was awarded to Siemens with PSI as a subcontractor for the system conception and realisation of the control system software including stand-alone operation. The control system was equipped with the most powerful process computers of that time to allow for realtime operations.

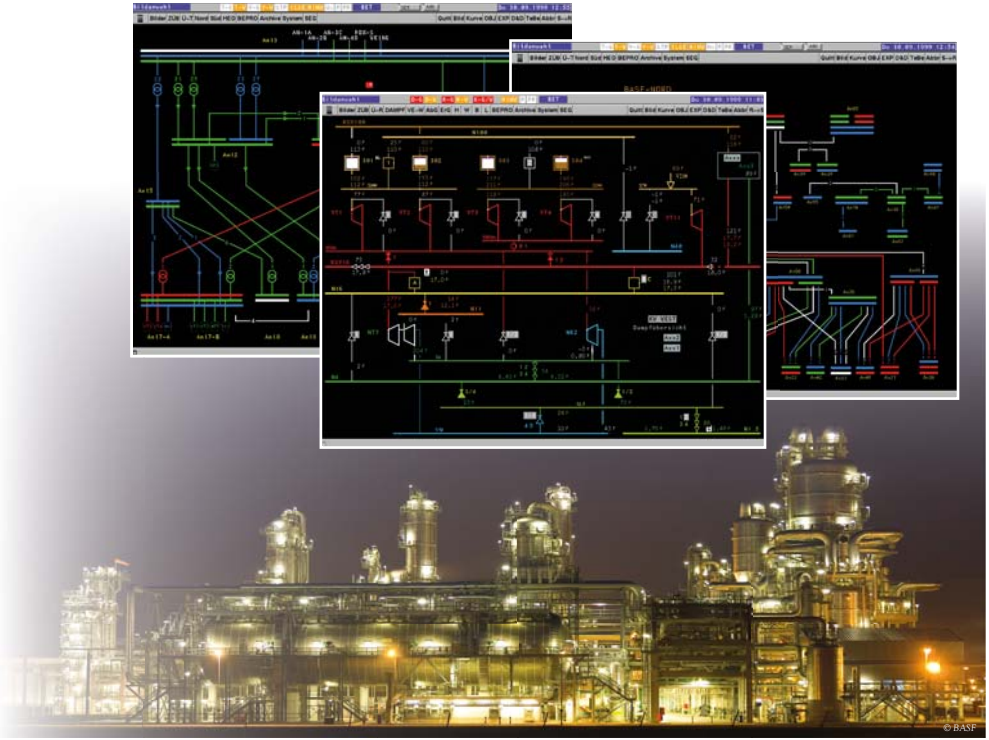
The appearance of workstations with the UNIX operating system also caused a technology change for large control systems. The savings in maintenance costs for process computers alone refinanced the modernisation of the control system with workstations as new hardware base in a very short period of time.

The realisation of this control system renewal was entrusted to PSI.

In order to fulfil continuously increasing requirements on network operations and planning, PSI has jointly implemented the IMENDO X-PORT interface solution with Austrian IMENDO GmbH for BASF.

With assistance from IMENDO X-PORT, all relevant network information from the BASF equipment databases is sent to the PSI control system, verified and prepared for the NEPLAN network planning tool.

In doing so, network planning always works with a current and verified realtime database in NEPLAN without the great effort and expense of manual data entry.



PSIcontrol - Control systems for operating rail electrification networks

The railways operate their own electricity network for supplying the rail network.

On the one hand, the requirements for monitoring and controlling these networks (transmission and rail electrification) are similar to those for regional system operators.

On the other hand, rail-specific conditions must be considered and corresponding functions must be implemented. Examples are:

- Special switching programs for rail electrification,
- Preview functions for planned switching operations,
- Tunnel monitoring,
- Simulation of moving trains,
- Network controller (transmission).

Having deliveredof solutions for all central switching centres (rail electrification) to Deutsche Bahn, PSI has received several demanding orders for rail electrification control systems from prominent European rail operators.

Thus, we are now also established in this segment of the network control market.

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Central control centre (ZES) of DB Energie

DB NETZE

The 15 kV rail electrification network from Deutsche Bahn is monitored and controlled by seven central control centres (ZES).

All 7 ZESs are equipped with PSI*control* systems. In addition, a central PSI*command* system supports workforce management operations (support tool for control centers - STCC).

A unique feature of rail electrification is the extremely high frequency of switching operations:

- Using the target state display, the state of overhead powerlines is shown after a future switching operation, in parallel to the current state.
- Switching programs allow for complex switching operations with standby supply and restoration of the normal state.

ZES Leipzig

ZES Borken

DB Energie - ZES Karlsruhe

DB NETZE

Trafikverket

TRAFIKVERKET

CITYTUNNELN

Swedish railways are supplied with electricity using networks on 132 kV and 15 kV voltage levels. These are completely managed with PSI*control*.

The PSI*control* control system is distributed to multiple sites with parallel operation.

For Citytunneln in Malmö, PSI has implemented the following functions (among others) based on PSI*control* in order to comply with the special tunnel system requirements:

- Emergency and fault clearance planning,
- Facility management and
- Video functions.

A unique characteristic is the tunnel installation with video monitoring. The control centre personnel can drag and drop the different cameras onto configurable displays.

Control centres at multiple sites

PSI*control*

PSI*control* Dispatcher Training Simulator for railway power supply

One important component of the control system is the PSI*control* Rail Dispatcher Training Simulator.

Within the same, the 132 kV and 15 kV networks are modelled.

Calculations of the 1-phase network and comprehensive modelling of the network protection allow the effects of reported faults to be simulated realistically.

As special feature, moving trains are modelled as movable loads within the simulator.

Simulation of moving trains

- Simultaneous modelling of up to 100 trains
- Simulator GUI allows for schedule entry
- Train-specific modelling
  - Express train
  - Freight train
  - Diesel train
- Load modelling
  - Acceleration profile
  - Breaking profile

Swiss Federal Railways

SBB CFF FFS

For Swiss Federal Railways, 2 control systems are being developed:

- EMS (**E**nergy **M**anagement **S**ystem),
- CCS (**C**atenary**C**ontrol**S**ystem).

The collective database contains all parameter data for both the EMS and CCS.

The EMS is a control system for the transmission network with power plant infeeds. Noteworthy functions are:

- Management of the rail transmission network,
- Extensive network calculations with forecast (EMS),
- Power frequency controller including stand-alone network modelling (EMS),
- Monitoring and optimisation of energy generation with rail power plants and frequency transformers.

The CCS supports monitoring and control of overhead lines. Noteworthy features are:

- Specific rail-based switching programs
- Topological colouring
- Diagram concept of catenary system operations.

Both systems are distributed at multiple sites in Switzerland. The user interfaces can be switched between German, French and Italian in online mode on each workplace. In both systems, Dispatcher Training Simulator as well as a robust outage planning tool are completely integrated.

ProRail - New central PSI*control* system replaces four existing control centres

ProRail

PSI AG received an order from the Dutch rail operator ProRail for the delivery of a central control system to monitor and control the 1,500 volt direct current overhead powerline network. The new control system will be based on PSI*control* technology and the current four control centres in Amsterdam, Zwolle, Eindhoven and Rotterdam will be replaced with one central control centre in Utrecht with a separate emergency control centre.

The project life span is planned to be for two years.

Further to numerous SCADA functions (supervisory control and data acquisition) and a robust outage planner, the central control system has even more rail-specific functions. Among these are the rail-specific switching programs as well as tunnel monitoring.

With ProRail, PSI has proven itself against large international competitors once more. After Germany, Sweden and Switzerland, the Netherlands is the fourth European country to use a rail electrification management system from PSI.

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