Redispatch 2.0: Automated processes and standardized data exchange easily implemented

Stable Power Grids Through Reliable Forecasting

R&D

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Intelligent Charging Management for the Smart Grid

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PSI

EDITORIAL

Dear reader,

We sincerely hope that you have started the New Year well, strong and healthy. The existing diverse challenges will continue to demand a great deal of strength from everyone involved. Particularly as in the pandemic digitalization is experiencing a real boost—not only in the energy industry. This is increasingly driving the adaptation of business processes.

For distribution network operators, this year's priority is the implementation of the extended requirements for the redispatch process due to the German Grid Expansion Acceleration Act. With our long-term expertise and our modular software solution PSIsaso/DSO, which is independent of the control system, we will support you to reliably implement these re-

quirements by October 1, 2021. Please, learn more about this focus in our title story as well as in specific application articles.

The importance of redispatch is also illustrated by a presentation held at the virtual PSI EE Info Days in November 2020, which attracted a re-

cord audience. Read more about this in the review of the successful online customer event.

Based on our group-wide PSI platform, we are working at full speed on new developments in our core products and further components as well as multi-cloud-based applications. With important acquisitions of leading providers of complementary software products as well as strategic partnerships, we want to achieve these goals even faster in order to offer you the best possible solutions.

Wolfgang Fischer
Business Unit Manager
PSI Energy EE

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Redispatch 2.0: Automated processes and standardized data exchange easily implemented

Stable Power Grids Through Reliable Forecasting

In the future, with the amendment to feed-in management fundamental under Redispatch 2.0, distribution system operators (DSO) will be obliged by the Federal Network Agency to participate in congestion management in upstream networks. This is intended to ensure a further important contribution to system stability. The modular software solution PSIsaso/DSO, which is independent of the control system, enables DSOs to summarize extensive forecasts and planning data and to reliably forecast future network conditions. As a result, the expanded requirements for the redispatch process due to the Network Expansion Acceleration Act (NABEG 2.0) can be implemented reliably on October 1, 2021.

A main component of the Grid Expansion Acceleration Act is the extension of redispatch to all generation and storage facilities >100 kW, regardless of their type. With PSIsaso/DSO (Security Assessment and System Optimization), distribution system operators can react flexibly to the changing legal requirements, especially with a further increasing share of renewable energy, and participate in planning and forecasting processes. A proven grid condition forecast with an optimal selection and dimensioning of measures makes it possible to design the effects in the grid transparently and efficiently.

Network condition forecasts as the basis for congestion avoidance measures

With PSIsaso/DSO, the network model from the control system as well as schedule and forecast data are continuously recorded and used to create network condition forecasts. Based on these, an evaluation of the upstream network operator's requirements can be carried out and, if necessary, the required measures can be initiated to avoid congestion in the operator's own network or in the network of the downstream network operator.

Secure processing of input data

The two modules PCOM+ and PSIsaso ensure the processing of input data such as the snapshot network model from the control system as well as the feed-in data, the forecast load data and the planned switching. This also includes, in particular, the topological distribution of feed-in and load data to subordinate areas, the cyclical processing of the time series and the calcula-

tions based on them. Among other things, PCOM+ exports network models in CGMES format, forecasted feed-in-management (Eins-Man) measures, reactive power potentials and network loss forecasts.

## Standardized data exchange with GLDPM

The GLDPM (Generation and Load Data Provision Methodology) module primarily provides the distribution system operators' forward-looking data to the transmission system operators to ensure the highest possible transparency in determining transmission capacities.

The following profiles are generated in CGMES format:
- Equipment Profiles to describe static data
- Steady State Hypothesis Profile for the description of motion data
- Topology Profile for the description of current topological relationships
- State Variable Profile to describe the results of a load flow calculation

The export and import functionality in CGMES format of PSI have been certified by ENTSO-E.

The GLDPM Implementation Guide compiles the relevant data. These mainly represent network data models of the distribution network for future periods (intraday, day-ahead and 2-day-ahead) as well as the load forecasts of the consumers and the feed-in forecasts of the conventional power plants and feed-ins of renewable energies.
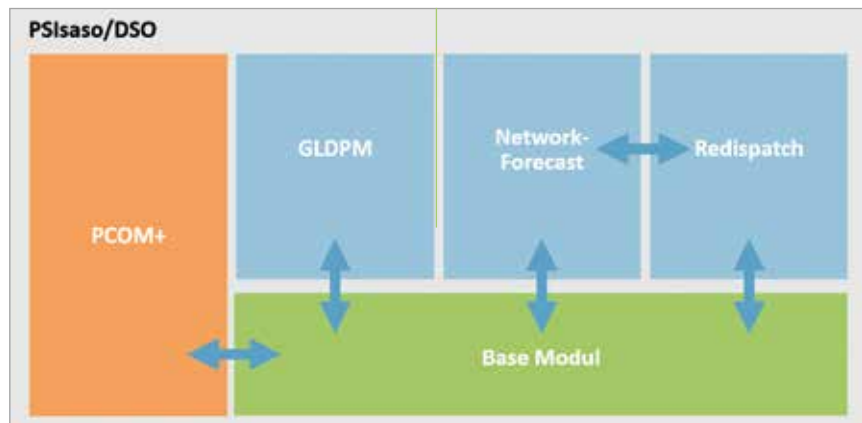
The main modules GLDPM, network condition forecast and the redispatch module are based on the PCOM+ and a PSIsaso basic module.

Module Network State Prognosis calculates future network state

Based on the imported network model and the feed-in and load forecasts as well as power plant schedules, schedules of controllable loads, renewable energy schedules and planned switching, the network state forecast module calculates the future network state for the period of typically three but also more days into the future in a grid of one hour or fifteen minutes. This is done in three steps:

1. Checking the voltages and flows

The contingency analysis is used to check whether the voltages and the flows in the base case and in the (n-1) case comply with the alarm limits.

2. Adjust

Topological measures are taken to try to bring about an improvement in one's own network with respect to the current violations. If current violations are still present after these adjustments, they are counteracted with the help of the feed-in-management (EinsMan) controller. Finally, the OPF calculation adjusts the reactive power sources and the stages of the tap changers.

3. Check by failure variant calculation

After the adjustment, the improvements are verified using another contingency analysis. The check also includes the allowable short-circuit power using a short-circuit calculation (either Takahashi or IEC).

As a result of the network condition forecast, the following data can be exported:
- Network model in CGMES format including load flow results in own and external network
- Forecast measures
- Export of time series to a control system: reactive power potential, network loss forecast

Cluster formation for control of resources

PSIsaso maintains for Redispatch 2.0 numerous communication relationships with upstream systems. For the redispatch network state forecast, data from the upstream or downstream network operators, from forecasting systems and from the control system are used. After the calculation of the network state, the determination of the findings as well as the measures and call-off dimensioning and cluster formation, the data and reports are ex-

ported to the upstream network operators, the network control system and to trading and billing systems.

The task of cluster formation is to group controllable resources with respect to the given cost and effectiveness. The desired clustering is to be coordinated with the upstream network operator. The measure dimensioning serves to determine the most economical measures to eliminate the bottlenecks. PSI provides two methods for this purpose: In the first procedure, a linear optimization problem

operator to a minimal variant without congestion and requirements. In order to be able to react to the different circumstances, the Redispatch module has a modular structure. Modules that are not required, such as measure dimensioning, call-off control and balance topics, can be deactivated and are taken into account accordingly in the license model. The network condition forecasts in a possibly simplified variant as well as the transfer of master and transaction data then play the essential role.

processing. A specific network state calculation is performed for the configured time slices. The redispatch module persists the sensitivities for further processing in the measure dimensioning. In the coordination process, there is a continuous exchange of information between the network operators. The distribution system operator therefore sends the information on flex data objects such as flex potentials (clustered if necessary), base line and flex constraints to the upstream system operator.
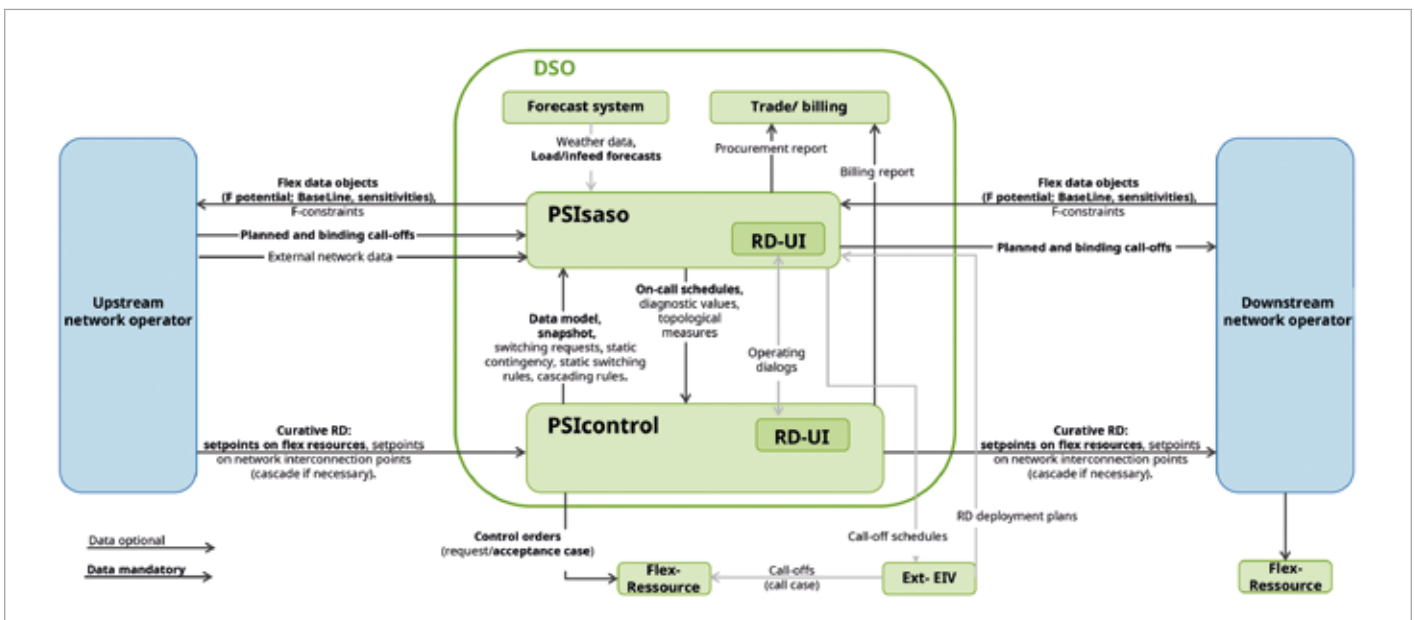
Redispatch 2.0: System overview.

is solved based on the input data (cost of flex resources, flex potentials and constraints, sensitivity to congestion, etc.). In the merit order method, the bottlenecks are solved in the order in which they are worst exceeded.

Modular design for different requirements

Distribution system operators are affected by Redispatch 2.0 issues in different ways. The extremes range from DSOs with their own congestion and requirements by the upstream network

Necessary coordination processes

The entire process is to be understood as an iterative sequence within the framework of a coordination process for mutual coordination of measures between network operators. With the obligation of a DSO to maintain a redispatch balancing group, the balancing group management also becomes part of the coordination process.

Each calculation cycle of the redispatch module starts with input data

This means that the upstream network operator is aware of the DSO potential and can include it in planning calculations. As the level of knowledge changes, the data records are periodically exchanged. The resulting binding calls of the upstream network operator are received by the DSO and taken into account in its implementation planning.

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R&D: ALigN research project—Integration of charging points into the low-voltage grid

Intelligent Charging Management for a Smart Grid

After a phase of hesitant model announcements by the automotive industry, electro mobility has now taken off and become a reality. The number of registrations of electrically powered vehicles is rising rapidly throughout Germany, due in particular to subsidies for the purchase of new vehicles. At the European level, the EU's "Clean Vehicle Directive" provision offers a great opportunity for the commercialization of electric vehicles, as around 45 percent of new publicly purchased vehicles are to be emission-free, i.e. clean, by 2025.

Most of the charging infrastructure is connected to the low-voltage grid, unless it is for larger customers or fleet parking. It is undisputed that the necessary amount of energy can also be transported for a full-scale expansion of electromobility. However, problems can arise with the power demanded, as a high simultaneity of charging processes occurs due to temporal concentrations, e. g., in the early evening or at midday.

Electro mobility spurs intelligent grid expansion

In order to avoid the risk of unwanted partial shutdowns or expensive network expansion due to the laying of new power lines or new local network transformers, the PSIsmartcharging software solution monitors and controls the connected charging infrastructure. In the research project ALigN (expansion of charging infrastructure through targeted network support), which PSI is conducting with Regionetz GmbH and the city of Aachen, among others, up to 960 charging points are to be integrated into the low-voltage network of Regionetz.

PSIsmartcharging offers the intelligent infrastructure for secure LV grid

Battery buffer storage for charging electric vehicles.

operation and can be integrated into the existing PSIprins or PSIcontrol grid control systems via classic interfaces, such as IEC 60870-5-104.

Nevertheless, when considering electromobility, it must not be forgotten that this is only the first use case for the integration of controllable loads. The expansion of sensors and actuators is an essential building block for bringing together the dynamics of generators, consumers and transport.

Robust automated control loops

In the affected low-voltage networks, potential bottlenecks are monitored by sensors. If the maximum allowable requested power is exceeded, the controller developed in the ALigN project intervenes and sends a signal to reduce the maximum charging power to the charging infrastructure. The assignment of the charging infrastructure to a bottleneck is done fully automatically via the topological search. Starting from the bottleneck, the house connections acting with a charging infrastructure are automatically assigned to a control loop. This means a correct automated assignment depending on the switching state of the network.

From prototype to monitored network

In the first project phase of the ALigN project, a prototype is being built that maps the aforementioned functionality. Six charging points connected to a transformer will be monitored and regulated down in the event of a bottleneck situation.
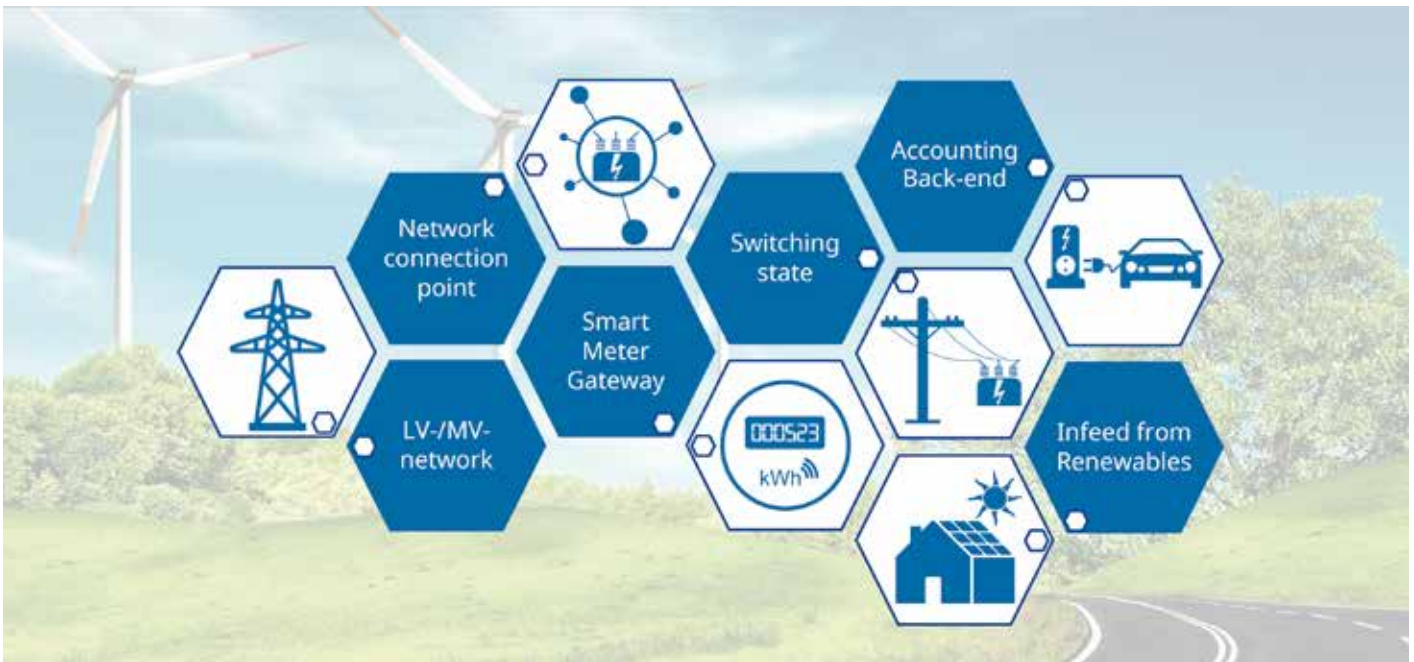
Graphical presentation of electric mobility in bus operation.

In the second project phase, the communicative connection of the charging stations will be established via the charging station information system (LiSy) of the project partner smartlab GmbH from Aachen. This is necessary because there is no standardized interface available for the network operator for a direct connection. Although the Open Charge Point Protocol exists at every charging station that is connected via a Charge Point Operator (CPO) backend such as LiSy, this interface can only ever be used exclusively by one communication partner. Since it is mostly the CPO backend that uses this interface here, there is no other standardized way for the grid operator to control it.

The TAR[1] Low Voltage (VDE-ARN 4100:2019-04) is correspondingly imprecise at this point. Although this requires "...charging devices for

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[1] *Technical rules for the connection of customer installations to the low-voltage grid and their operation.*

electric vehicles with a rated power >12 kVA...a possibility for control/regulation...by the grid operator...", the technical implementation required for this is not defined further. It therefore remains to be seen which direct and secure interface for the control of controllable loads by the grid operator will become established. The functions of a smart meter gateway will certainly be helpful here as a transport channel. Until then, PSIsmartcharging offers a wide range of available interfaces for the control of controllable loads through the subordinate and proven network control system PSIcontrol.

Public transport as a driver of charging management

As might be expected from the introduction, a timely use case for charging management can be found in local public transport (ÖPNV). A large number of e-buses need to be charged in a timely manner so that they can serve a route on time in the morning. The simultaneity of charging pro-

cesses must be planned in such a way that the operator incurs only minimal costs for the power charge and the network connection thus required has correspondingly low power.

In several projects, the PSIsmartcharging software demonstrates its capabilities in this regard. In addition to the actual charging process, the so-called preconditioning of the buses must also be taken into account. This takes into account the air conditioning of the passenger compartments at the time of disengagement, so that the capacity of the batteries has to be used less. The cities of Hamburg and Berlin use PSIebus, a depot management system in which the load and charging management PSIsmartcharging has been fully integrated. This enables them to ensure the operation of their electric bus fleets even with limited electrical power. ◉

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News: Strengthening of energy networks through acquisition of Prognos Energy

Forecasting Weather-dependent Redispatch

With the acquisition of Potsdam-based Prognos Energy GmbH in June 2020, the PSI Group is strengthening its position in the field of energy networks. Prognos has specialized in forecasting energy feed-in from wind energy and photovoltaics since 2015 and has a mature software system for spatially and temporally high-resolution and precise power forecasts.

With increased meteorological know-how and additional functionality, the PSI software is to be expanded for the weather-dependent redispatch of distribution network operators and for the reduction of control energy costs. In the PSI Group, Prognos Energy GmbH will be assigned to the Energy Management segment, adding high-resolution forecasting to the existing, extensive software product portfolio for transmission and distribution system operators. In the future, PSI will link the forecasting system with the numerous forecasting systems based on industrial artificial intelligence.

Improved Automated DSO Redispatch

In recent years, PSI has established the GLDPM platform for communication between transmission and distribution network operators for its control system customers. This platform is prepared for the connection of the AI-based decision support system SASO and the distribution grid redispatch system so as to communicate with the transmission system operator from there or to control the own energy or energy from local flexibility markets.

With this software combination, the distribution grid operators can optimize weather and load-dependent rerouting and control energy use in their network. The forecasting expertise and software will further improve the decision-making quality of the automated DSO redispatch. ◉

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News: PSI acquires Swiss network planning software specialist NEPLAN AG

Cloud-based Network Planning Management

In October, PSI acquired the Swiss company NEPLAN AG. Since 1988, NEPLAN has been providing technologically and functionally leading software for the planning, analysis, simulation, technical and economic optimization of energy network expansion for electricity networks, as well as in the cross-linked areas of gas, water and district heating.

NEPLAN's cloud-capable software is used in network planning and asset management by more than 500 customers in 110 countries worldwide.

Algorithms for real-time network calculations

The real-time network calculations in the control systems are enriched by additional network calculation algorithms from NEPLAN planning software. This applies analogously to the gas network simulation PSIganesi. New algorithms are to be developed jointly in the future and marketed via the three product lines electricity control systems, gas control systems, network planning.

Numerous connections can be created between network planning (PSIneplan), field force management (PSIcommand) and the control system (PSIcontrol), which significantly reduce the maintenance costs of the network equipment through an extended planning horizon and precise aging models and improve availability (SAIDI). Integrated Deep Qualicision Optimization optimally achieves national regulatory goals while safeguarding employee interests. ◉

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R&D: PSI software integrated in flexQgrid renewable energies project

Quota-based Grid Traffic Light Model

As part of the flexQgrid research project coordinated by Netze BW GmbH, PSI is developing a decentralized, semi-autonomous grid control system for online operation. Furthermore, PSI realizes the integration of a quota-based network traffic light concept into a real control system environment.

In this research project, PSI is implementing a quota-based network traffic light model and will evaluate it together with the project partners with regard to its practical suitability. For this purpose, a control system field test environment will be connected to the control system of Netze BW in monitoring mode, so that the extensions can be tested with real process data without influencing the operational system.

Decentralized network control in field test environment

In addition, a decentralized grid control system is installed in the field test environment with the software solution Intelligent Grid Operator PSIngo. The results of the field test provide valuable information for the further development and integration of the grid traffic light model into real grid operation.

Interaction of all market participants

In the flexQgrid research project, which is scheduled to run for three years and is funded by the German Federal Ministry of Economics and Technology (BMWi), the distribution grid, regional power generation, controllable consumers and market participants such as aggregators are again to interact. The focus is on the twelve-month field test starting in August 2021, involving two medium-voltage and three low-voltage grids with flexible consumers such as heat pumps, battery storage and electric vehicles.

If a bottleneck is forecasted with simultaneous utilization of the grids and a "yellow phase" occurs, the aim is to avoid the traffic light color "red" and thus intervention by the grid operator in the form of the automatic grid controller PSIngo via release quotas for generation or consumption plants. Netze BW GmbH is the largest network company for electricity, gas and water in Baden-Württemberg.

More at: www.netze-bw.de/News/netze-bw-projekt-flexqgrid ◉

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Representatives of the companies and institutions involved in flexQgrid.

News: PSIcontrol 4.8 with new web and object browsers and extended network fault processing

New Functionalities in the Network Control System

In addition to web and object browsers, the network control system PSIcontrol offers in Release 4.8 an automatic event overview, a virtual keyboard and the copying of content to and from third-party applications. Additional parameterization options, deactivation of the monitoring of limit values and the expansion of network fault processing (FLISR) as well as an improved shift book round off the new range of functions.

With the help of the object browser, all objects of the control system can be displayed in hierarchical form. States and values from the process
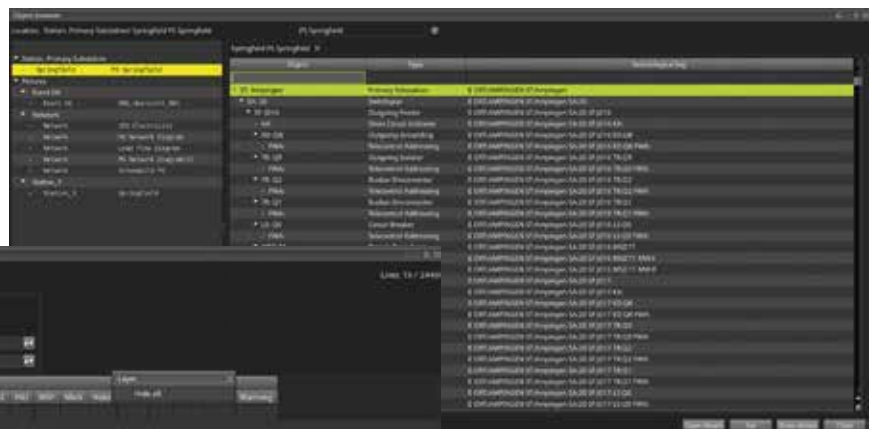
Hierarchical display in the object browser.
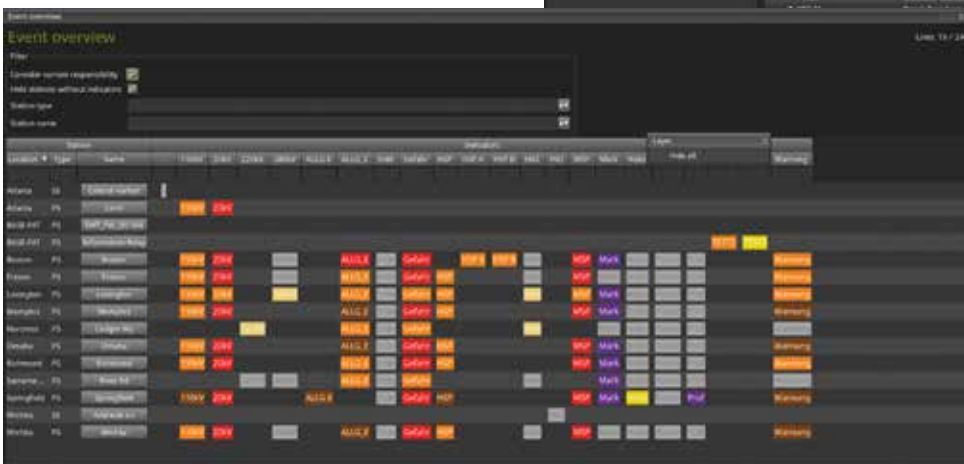
Automatic event overview.

image and further information from the static data model can be shown in a detailed view.

Automatic event overview and virtual keyboard

The automatic event overview displays an overview generated from the data of the static data model in the online system. Attachments and the associated indicators are presented in a list view. In addition, user-defined key bars and parameterized list settings can be saved as default settings for all users. Inputs can now also be

made alternatively via a virtual keyboard.

Using the web browser to access the control system

Users now also have the option of operating the control system with a web browser. This no longer requires a locally installed Java client; instead, all control system functions can be operated via a secure connection, even with multiple virtual monitors. The system administrator decides whether this browser control station operates with full or restricted rights.

Extended parameterization and deactivation of limit values by customers

Furthermore, in the new release, some of the settings previously configured by PSI have been switched to parameterization by customers, such

as the assignment of layer designations for process images. Window options can also be used to show and hide additional information such as the display of the tele control state, and new window options can be assigned to image variables in the development environment. In addition, it is possible to temporarily deactivate and log changeable limit values online in the operating window.

Network fault processing (Fault Location, Isolation and Service Restoration-FLISR) has been extended to include the evaluation of impedance protection zones. The impedance zone is determined from the time difference between excitation and tripping of the protection, which provides information on fault distance. The fault zones determined from the

intersection of all impedance zones are highlighted in the process image on the line.

Improved shift book

The handling of the shift book has been rethought and consistently improved. The shift change can now be executed either as a handover or as a takeover and is changed separately for each line. The shift change log shows on a separate tab each the extract from the operating log, the pending alarms and the open operations at the end of the shift. The log is saved for each shift change and can be viewed at any time. ◉

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Events: Virtual PSI EE Info Days 2020 in review

New Upgrades and Releases on Stage

The PSI EE Info Days took place virtually on 11 and 12 November 2020. With more than 400 registered customers, partners and interested parties, 100 of them international, a new record was set. Participants from Asia and the USA joined early in the morning before 3:00 am, despite the large time difference.

In addition to upgrades, new functions and improvements in PSIprins 8, the focus was on the new release PSIcontrol 4.8 with e.g. new web and objects browsers and expanded network fault processing.

From the PSIcommand environment, the developments as well as the integration into PSIcontrol (or another control system) were discussed. With the new switch request management as well as standard interfaces, the entire life cycle of a switch is comprehensively covered.

management of generation and loads. Field reports from installations in the field rounded out the presentation.

The questions asked in the chat were answered comprehensively by the speakers directly afterwards. Despite the lack of direct and personal contact, there was lively participation from the participants. Questions that were still open were answered in writing. The next Info Days in the fall of

Making-Of—a look behind the scenes.

The presentation on the PSIsaso/DSO system attracted a record audience. It offers comprehensive support for distribution network operators for the "Redispatch 2.0" processes, which will become mandatory in the fall of next year.

The Intelligent Grid Operator PSIngo was also demonstrated with AI-based functions for increasing network transparency as well as the

2022 will again be held in the usual face-to-face format. ◉

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Redispatch 2.0: ENERVIE Vernetzt relies on redispatch solution PSIsaso/DSO

Extended Redispatch 2.0 Process Requirements

The regional distribution network operator ENERVIE Vernetzt from South Westphalia has commissioned PSI to implement the PSIsaso/DSO solution. This will enable the operator to summarize extensive forecasts and planning data, forecast future network conditions and reliably implement the expanded requirements for the redispatch process due to the amendment to the Network Expansion Acceleration Act (NABEG 2.0) on 1 October 2021.

The PSI system for "Security Assessment and System Optimization" (SASO) is a modular application for distribution grid operators that is independent of the control system. It enables them to participate in planning and optimal selection and dimensioning of measures.

Cost-effective modular concept

PSIsaso/DSO continuously records the network model from the control system as well as schedule and forecast

> ENERVIE Vernetzt GmbH, a subsidiary of the ENERVIE Group (Hagen/NRW), builds and operates networks and systems in the South Westphalian region for distributing electricity, gas and water. As a major network company, it is a competent infrastructure service-provider supplying around 400000 customers and opening up the electricity and gas network to all network customers and suppliers in a non-discriminatory manner.

The PSI control system in use at ENERVIE's control center.

forecasting processes of the new redispatch regime and to design the effects in their own network transparently and efficiently by means of a proven network state prognosis with

data and uses these to create network condition forecasts. Based on these, the requirements of the upstream network operator are evaluated and the necessary measures to avoid congestion in the own network or in the network of the downstream network operator are initiated.

Thanks to the modular concept, different customer requirements can be implemented precisely and cost-effectively. In addition to the "Extended" version used by ENERVIE Vernetzt, a "Basic" version offers a variant specifically for network operators with a simple network structure and no bottlenecks in their own network.

ENERVIE Vernetzt already uses a PSI network control system. This allows a very close coupling of both systems and the implementation of further requirements, e.g. within the framework of the implementation guidelines for GLDPM and SOGL. In principle, any solution based on PSIsaso/DSO can also be used with control systems from other manufacturers without any problems. ◉

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News: Control system software for operations management center of Amprion GmbH

Optimized Operation and Maintenance Processes

The transmission system operator Amprion GmbH has commissioned PSI with the implementation of PSIcontrol as the central solution for the operations management center. The goal is to optimize operations and maintenance processes.

The task of the operations management center is to record operationally relevant messages from the entire Amprion network area quickly and efficiently and to initiate appropriate measures.

prioritized and visualized in a targeted manner. An integration of geographic and factual data from the existing Amprion systems enables events to be localized quickly. If required, necessary measures can be initiated imme-

Amprion GmbH, based in Dortmund, operates an 11 000-kilometer high-voltage network with around 2000 employees at more than 30 other locations. In addition, the transmission system operator takes on overarching tasks for the interconnected networks in Germany and Europe.

PSIcontrol network image high voltage.
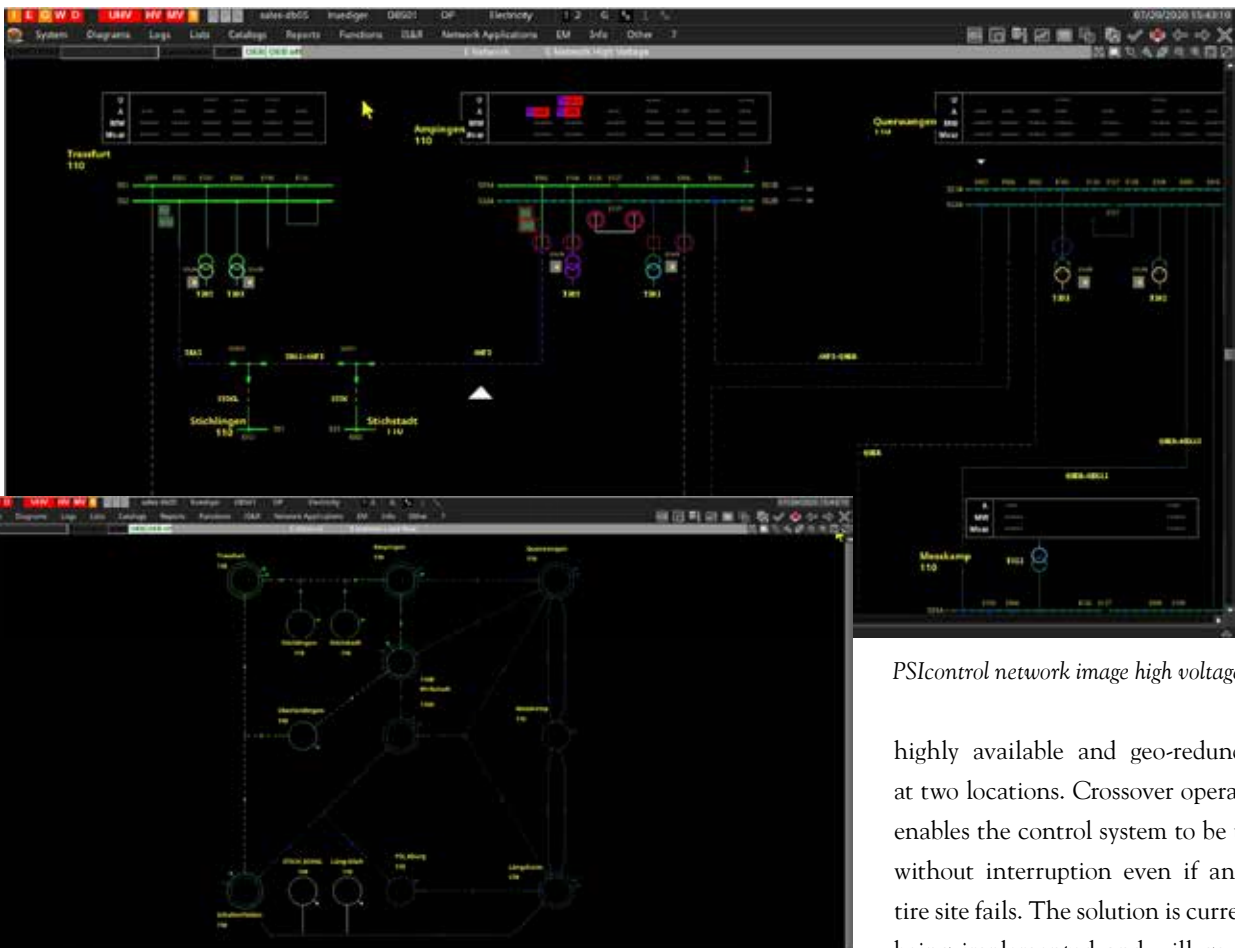
PSIcontrol network image load flow.

highly available and geo-redundant at two locations. Crossover operation enables the control system to be used without interruption even if an entire site fails. The solution is currently being implemented and will go into productive operation at the beginning of 2022.

On the basis of PSIcontrol, messages are recorded via a control center coupling from the network control system of the group switching lines and from telecontrol stations, grouped,

diately and fully documented via an interface from PSIcontrol to an Amprion ticket system.

In order to guarantee maximum availability, the PSI solution is set up to be

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Redispatch 2.0: PSIsaso/DSO meets curative requirements at E.ON
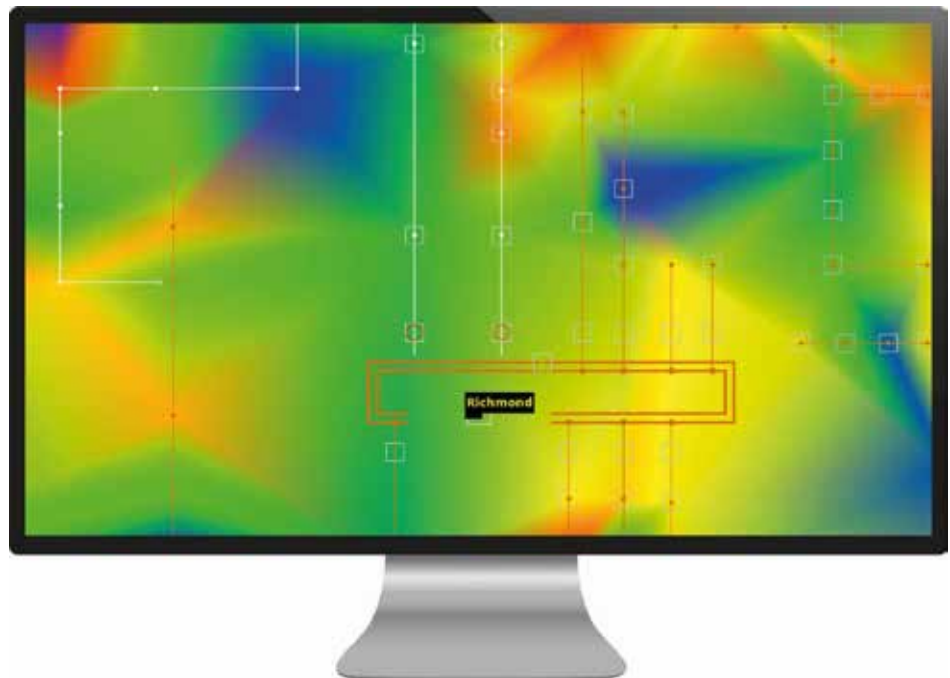
Extended Redispatch 2.0 Modules

The energy group E.ON SE has commissioned PSI Software AG with the implementation of Redispatch 2.0 components based on PSIsaso/DSO. In addition to the coordination of the new planning process, these also offer high-quality network model forecasts in the control system environment and control system-related solutions. Thus, the extended requirements for the redispatch process due to the amendment of the new Network Expansion Acceleration Act can be reliably implemented.

These curative measures which become spontaneously necessary should be coordinated with the planned calls received by redispatch. This function is now to be integrated for Redispatch 2.0 in the existing feed-in management standard module of the PSIcontrol control system.

Even in the run-up to ENABEG 2.0, all nine distribution system operators of the E.ON Group are relying on the know-how of PSI as a long-standing partner. Important future requirements, such as network condition forecasts and feed-in management (EisMan), have already been jointly specified and successfully implemented.

Grid model forecast data sets and curative congestion management

These modules are being extended at E.ON under "system control in real time" (ASE). Essential new features include supplying an external redispatch system with high-quality network model forecast datasets and implementing the resulting calls. Curative congestion management and the associated extensive reporting process control and documentation are also applied. Apart from preferred topological measures, the necessary foresight for network stability within the forecast horizon also comprises the analysis of outage variants, short circuit findings, reactive power potential and network losses. The generation of network model forecast datasets with a

Display of a "heat map" in the PSIsaso module of the PSI network control system.

view of at least 36 hours into the future is an elementary component for redispatch in the E.ON Group.

Necessary curative measures in case of forecast deviations

If grid-threatening conditions arise due to forecast deviations from the real loads and feed-ins, curative measures are required. This involves both the stability of the company's own network and unplanned "additional demands" from upstream network operators.

This will enable all network safety measures, including within the framework of the EnWG, in the area of monitoring and controlling decentralized inputs to be largely automated.

All functions will be available to each of the nine E.ON distribution network operators in time for the start of Redispatch 2.0. ◉

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E-mobility: SWMI integrates charging infrastructure with cloud-based platform PSIngo and AI

Automated Control of Low-Voltage Networks

SWMI Infrastruktur GmbH & Co. KG, a company of Stadtwerke München and network operator of the local energy supply network, relies on the Intelligent Grid Operator PSIngo for the integration of the charging infrastructure for electric vehicles into the local low-voltage networks.

The innovative operations management concept for intelligent and automated distribution networks allows a central network status determination for the early detection of impending bottlenecks. This ensures a stable and reliable operation of the low-voltage networks.

Avoiding grid overloads

Charging in the private sector in particular, places serious demands on the maintenance of supply security. With a high simultaneity of powerful consumers such as heat pumps, night storage and the fast charging of electric vehicles, grid overloads can occur at times.

Digitization of distribution grids

The cloud-based smart grid platform PSIngo provides grid operators with a scalable and AI-based solution for the automated monitoring and control of low-voltage grids. This enables the rapid and economical digitization of distribution networks, brings a new transparency to network operations and ensures the maintenance of supply security.

SWMI's ultimate goal is to provide the customer with the highest possible comfort during the charging process. With the gained observability of the low voltage network, SWMI aims to optimize the use of existing line reserves and avoid frequent unplanned and prolonged network interventions.

Self-learning method for AI-supported network condition estimation.

Based on many years of experience in the smart grid sector as well as the powerful combination of neural networks with Deep Qualicision, PSI has developed a self-learning method for AI-assisted network state estimation that also manages with incomplete network state information. ◉

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E-charging station of SWM in Munich.

E-mobility: Grid-based charging management of electric vehicles successfully tested

Intelligent Grid Condition Monitoring

The prototype for the digital low-voltage grid of the future has proven its practical suitability in a pilot project of Rheinische NETZGesellschaft and RheinEnergie. In two low-voltage networks in Cologne, the PSI intelligent grid operator (PSIngo), an intelligent network status monitoring system for the network-based charging management of electric vehicles at public charging points, was successfully tested.

The previous charging infrastructure for electric mobility has been integrated into the grids without any problems. However, with an increasing number of charging points and simultaneous charging processes, overloading of local network transformers and low-voltage cables as well as voltage band violations can occur in the medium to long term. As an alternative to conventional grid expansion, it is possible to control charging processes with innovative smart grid technology to avoid bottlenecks, a procedure that has now been successfully tested in Cologne.

RheinEnergie e-vehicle at a public charging station.

points in the grid. This provided the PSIngo intelligent grid operator with the necessary data for the reliable cal-

about the network status. As a result, the operational reserves of conventional network design can be better utilized.

If too many charging processes were started simultaneously in a local network and limit values were violated, PSIngo immediately recognized the situation and ensured permanent network stability with low power adjustment of charging processes without overloading cables or transformers.

In this way, PSIngo ensured transparency in the two local low-voltage networks and created the conditions for the further expansion of electro-mobility. This is a clear benefit for climate protection and air quality, not only in Cologne but also in the future throughout Germany.

> *The successful digitization of the selected low-voltage networks in Cologne has clearly demonstrated that the complexity of the internal and external interfaces to be integrated can only be mastered through excellent teamwork and mature IT technology.*
>
> **Dr. Tobias Kornrumpf**
> Rheinische NETZgesellschaft.

In the one-year pilot project, modern sensor technology (voltage and current meters) was installed at selected

culation and continuous monitoring of the network utilization in real time. The monitoring creates transparency

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E-mobility: Rapid commissioning of the charging management system for e-buses at BVG

Optimal Dispatching and Charging Infrastructure

In November 2020, PSI Transcom GmbH was commissioned by the Berliner Verkehrsbetriebe (BVG) with the delivery of the PSIebus depot and charging management system. This enables the optimal disposition of the electric buses in connection with the charging infrastructure and ensures the best possible vehicle availability. Just seven weeks after the start of the project the PSIsmartcharging management system integrated in PSIebus was successfully put into operation.

The PSIebus depot and charging management system will initially coordinate and dispatch the vehicles at the Indi-

tor into a holistic charging strategy and also controls and monitors the preconditioning of the buses. Communication with the depot manage-

was presented and proven in specified test scenarios of the BVG. In the further course of the project, the entire charging infrastructure of the depot of the manufacturers Ekoenergetyka and XCharge will be integrated into the system in phases and controlled centrally.

As the largest local transport company in Germany, Berliner Verkehrsbetriebe (BVG) operates a large part of the local public transport system

Depot and charging management from PSI controls BVG's e-bus fleet.

ra-Gandhi-Straße depot and ensure that all buses are reliably ready for use at the start of their journey.

The system integrates, monitors and controls the charging infrastructure and coordinates the charging processes. Thus, it converts the operational requirements from the bus sec-

ment system integrated in PSIebus takes place via the VDV interface 463 developed by PSI.

Initially, the charging stations of the manufacturer Ekoenergetyka were connected. For their technical integration PSIsmartcharging uses the OCPP standard. The functionality

in Berlin with subways, streetcars, buses and ferries. At the turn of the year, BVG had 138 e-buses in regular service. ◉

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News: Scenarios for feeding hydrogen into the gas transmission grid as well as upgrades for Thyssengas

Conversion of Regenerative Electricity into Green Gas

PSI Software AG has implemented a test system based on PSIganproda 5.1 for Thyssengas GmbH. With it, scenarios for hydrogen feed-in into the existing Thyssengas GmbH gas transport network can be examined and upgrades of the existing reconstruction systems prepared.

In a consortium with Gasunie Deutschland GmbH & Co. KG and TenneT TSO GmbH, Thyssengas is planning to implement the "ELEMENT ONE" project in Lower Saxony for sector coupling on an industrial scale. Regenerative electricity from offshore wind farms is to be converted into green gas. In several stages, a powerful electrolyzer is planned for the production of hydrogen with a capacity of up to 100 MWel.

Distribution of gas qualities in the network

PSI has been supporting Thyssengas as a service provider in the operation of the calibrated reconstruction systems for determining billing figures since 2008. The calibrated reconstruction system PSIganproda calculates the distribution of the gas properties in the network.
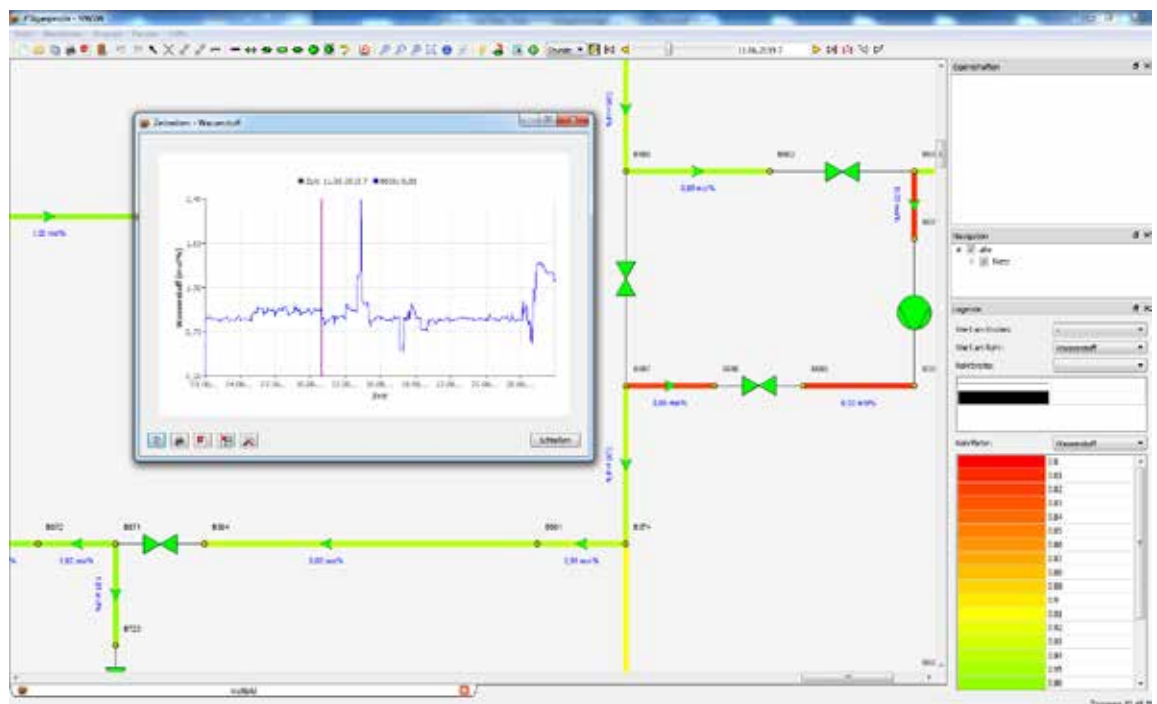
Extended graphical display options

In the first expansion stage of ELEMENT ONE, there is an option to feed hydrogen into the reconstructed H-gas transport networks. In test scenarios, the propagation of hydrogen in the network is calculated by PSI's test system. The current billing processes are not affected since the test system runs on separate hardware and software using the revised PSIganproda V5.1. It has a fundamentally modernized user interface with extended graphical display options.

In addition, the calculation options have been expanded to include all gas properties described in ISO 12213-2:2006. This also allows for an alternative calculation of the compressibility factor according to AGA8-DC92. Control plans allow easy adaptation and comparison of scenarios. Performance improvements allow monthly calculation results to be available within a few seconds.

Evaluation of scenarios by determining of measurement uncertainties

As an additional module in the evaluation of scenarios, PSIrekomu is used

Graphical representation of the hydrogen content in the network.

to determine the measurement uncertainties. In a Monte Carlo simulation, the changes in the results are considered in the event of random fluctuations in the input data. ◉

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News: Business Unit PSI Gas & Oil renamed PSI Gas Grids and Pipelines

Software Competence for Gas Grids and Pipelines

PSI Software AG renamed the previous business unit "PSI Gas & Oil" to "PSI Gas Grids and Pipelines". The move emphasizes the industry's transformation from CO_2 heavy gases and liquids to gases and liquids that are lower in or neutral/free of CO_2. PSI is currently involved in research and pilot projects to dramatically increase the share of these sustainable energy forms.

The gas grid, with high storage capacity (seasonal storage) and large-scale energy transport, is becoming the most important guarantor and opportunity for expansion for increasingly volatile energy generation from wind and solar energy in countries like Germany that are undergoing an energy transition.

Intelligent control of decarbonized gases and liquids

With the PSIgassuite and PSIpipelines product suites, PSI Gas Grids and Pipelines provides software solutions for energy supply, the transport and storage of natural gas, green gas, CO_2-neutral gas, biogas, LNG, biodiesel, synthesized eFuels, crude oil and refinery or chemical products as well as hydrogen, oxygen and CO_2 recycling composite pipelines.

Software for energy supply, transport and storage

With PSIganesi, the use of renewable energies and hydrogen in the network can be simulated and the gas composition tracked taking these injections into account. This is the only way—when mixing various injection gasses—to ensure the required gas composition at the withdrawal point for the customer. This also includes the actual or origin-related CO_2 content.

Solving volatility problems of renewable energies

PSIganesi can be used to simulate the use of renewables and hydrogen in the grid, and to track gas characteristics with the feed-in taken into account. This is the only way to ensure the required gas quality at the point of withdrawal for customers, which includes the actual or origin-related CO_2 content, given the complex mix of different feed gases.

Improved leak detection for pure hydrogen

Hydrogen is the most volatile molecule, which is why the leak detection software has been improved by a power of ten not only in order to reliably detect contamination and explosion hazards but micro-quantities, pumping operations and thefts as well.

Sector coupling through power-to-gas and power-to-heat

The product suites are continuously enhanced based on the PSI platform. For example, PSIgasguide—used for optimizing the gas grids current and future operation modes—has been newly developed and PSIcarlos—used for the planning of transporting liquids in pipelines—has been modernized.

Integration of artificial intelligence processes in pipeline control

The business unit is also involved in research projects including MathEnergy that develops mathematical methods for sector coupling Power-to-Gas (P2G) and Power-to-Heat (P2H) and promotes the integration of artificial intelligence methods in pipeline control.

With the renaming, the URL will also be adjusted to psigasandpipelines.com.

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Read the ENERGY manager online:
www.psi.de/en/psi-pressevents/customer-magazines/

News: Air Liquide Germany upgrades control system based on PSIcontrol 7.9

Safe Operation of Transport Pipelines

Air Liquide Deutschland GmbH has commissioned PSI with the upgrade of its control system based on PSIcontrol Version 7.9 with integrated leak detection and location system PSIganesi. In the future, the software solution will ensure safe control and monitoring of transport pipelines for oxygen, nitrogen and hydrogen.

The PSI leak detection and location, which is already integrated into the control handling of the acceptance processes. A large number of user-oriented functions in the control system also

greatest possible transparency of all technical operating processes at all times.

Air Liquide Deutschland GmbH supplies around 300 000 customers with around 4500 employees. The company supplies industries such as aviation, automotive, food and beverages, chemicals, steel, electronics, energy as well as customers in the healthcare sector. In the Rhine-Ruhr area, Air Liquide supplies the chemical, petrochemical and steel industries with gaseous oxygen, nitrogen and hydrogen via a pipeline network of around 500 km.
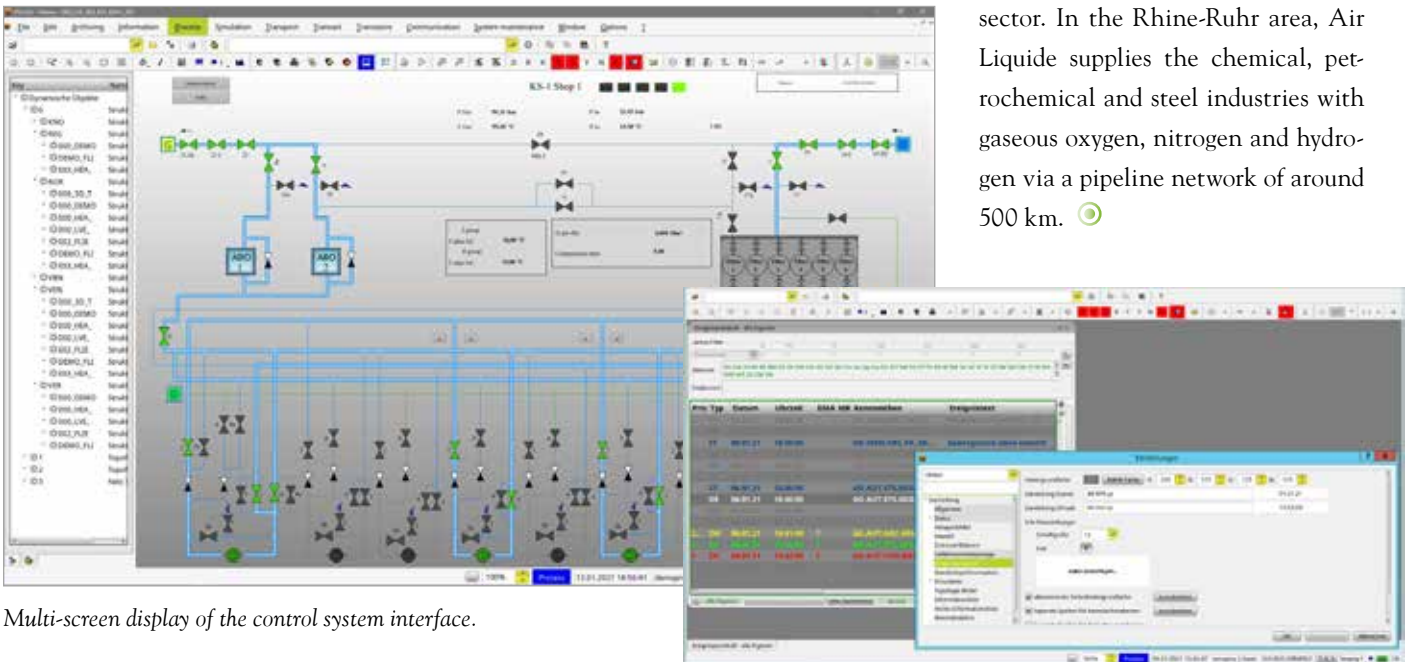
Multi-screen display of the control system interface.

Multiple setting options by the user.

system, enables leaks to be detected quickly and reliably. PSI has extensive experience with TÜV requirements for leak detection and location, which speaks for an efficient and successful

support safe and fast analysis of operating situations. These functions provide the dispatcher with the

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Update: The PSI Group will be presenting end-to-end, highly available and economical software solutions as well as cloud-based applications for the energy industry at the E-world 2022 in Essen from 8 to 10 February 2022.

E-world
energy & water

8.–10.2.2022
ESSEN/GERMANY
www.e-world-essen.com

News: PSI supplies new SCADA system to Polska Spółka Gazownictwa

Reliable Transport of Gaseous Fuels

Following a complex procurement process, Poland's leading gas distribution system operator, Polska Spółka Gazownictwa sp. z o.o (PSG), has awarded PSI Polska Sp. z o.o. with the implementation and maintenance of a new SCADA system.

P SI Polska will replace a number of existing systems from different suppliers with a single SCADA solution covering all PSG organizational units nationwide. The new system will be operated redundantly at two geographically distributed data centers. The contract provides for the implementation of the SCADA system over a period of

PSG gas station.

36 months, followed by a five-year system maintenance phase. ◉

Polska Spółka Gazownictwa, a PGNIG Group company, is Europe's largest operator of gas distribution network systems. PSG ensures safe transmission of gaseous fuels directly to end users via a nationwide distribution network and handles gas quality and volume measurement.

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Events: Review of the online annual meeting of the PSIcontrol user group (PAG)

Green Software for Gas Grids and Pipelines

Due to the pandemic, the PSIcontrol User Group (PAG) meeting, originally planned in Leipzig, took place on November 11, 2020 as a web conference under the motto "Intelligent Green Software". With presentations on the latest developments and cloud-based applications from PSI's Gas Grids and Pipelines business unit, the participating customers were also able to obtain comprehensive information online.

A fter the welcome by Business Unit Manager Dr. Simone Bauer and CEO Dr. Harald Schrimpf, the further developments of the 2021 release of PSIcontrol, which is based on the PSI platform and its roadmap were presented. In addition, the work results of the user forum the day

before were reported. Other topics encompassed Master Data Management, visualization and Postgres as an alternative RDBMS.

Furthermore, information on initial experiences and the processes of the GOup service was provided. Regarding the market area mergers, it was

also shown how PSI software can support rapidly changing requirements. Moreover, topics about innovations such as the MathEnergy research project, the neighborhood solution and the Multi Energy Hub were presented. There was also a focus on hydrogen injection in distribution networks and the consequences for gas transport in blending. The first PAG of the year took place online on June 3, 2020. ◉

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News: RheinEnergie Trading successfully puts PSImarket into operation

Essential: Flexibility and Performance

PSI Energy Markets has successfully put the energy trading and risk management system PSImarket into production at RheinEnergie Trading GmbH. The focus of the scope of services is on trading functions and portfolio management as well as risk management for electricity and gas. PSImarket thus replaces the previous legacy system.

For RheinEnergie Trading (RET), flexibility and performance are essential for energy trading and portfolio management. With the broad functionality, advanced software technology and extensive configuration options of PSImarket, business processes can now be mapped faster, more flexibly and more cost-efficiently.

> *RheinEnergie Trading has very extensive functional and high performance requirements for the ETRM software. These could be fully mapped with PSImarket, whereby RET achieved a significant simplification of the application landscape and improvement of the work processes.*
>
> **Matthias Herth**
> Project Manager
> RheinEnergie Trading

RheinEnergie Trading GmbH is a wholly owned subsidiary of RheinEnergie AG and is used by the latter and its partners as a central market access point. The company also offers its services in the purchase and trading of energy and energy-related products to external customers in the Rhineland region and throughout Germany.

Smooth migration of existing data in the legacy system

The migration of the data existing in the legacy system was carried out completely and smoothly with the help of the tools available as standard in PSImarket. The active involvement of the customer's employees and PSI's proven approach in many projects ensured the successful completion of the project.

Pitt Söker, Head of Data and Requirements Management, adds: "Considering the complexity and scope of the project, greater challenges were to be expected. Due to the intensive collaboration between the teams at PSI and RET, the project was completed on schedule." ◉
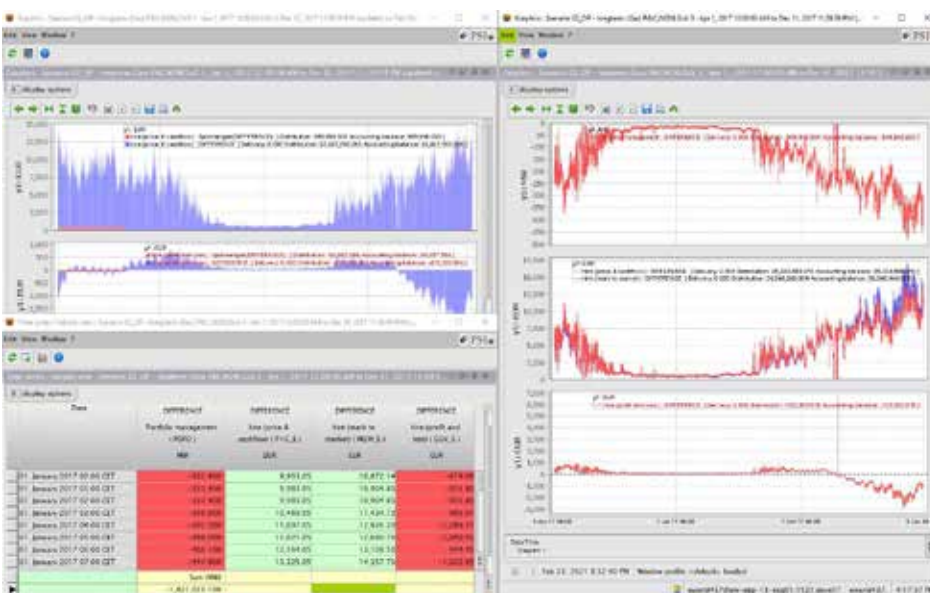
Example of embedded business intelligence (BI) dashboard in PSImarket.

Product report: PSImarket supports complete deal life cycle

Management of PPA

With the newly integrated contract type for Power Purchase Agreements (PPA) in the energy trading system PSImarket, PSI offers a user-friendly solution for the mapping of complex and long-term power supply contracts.

The mapping covers the complete deal life cycle from planning and evaluation to operational and financial processing and settlement, and includes regulatory reporting if required. PSImarket thus offers the optimal tool for marketing production from renewable energies. PPA contain contractual provisions that go far beyond classic supply contracts in the electricity market. The uncertainties and volatility on the generation side are addressed, for example, with limits for output and quantities in defined delivery periods or complex take-or-pay price regulations. Different scenarios for production and market prices (hPFC) are often used in the assessment.

Seamless use of PPA in portfolio and risk management

PSImarket offers a powerful and flexible time series management and for-mula system for this purpose and can display any price formula. PPA can be used seamlessly in the system's portfolio and risk management and can be used in the schedule registration, settlement and reporting modules, such as REMIT.

Management of green power certificates

In PPA for marketing electricity from post-EEG plants, revenues from green power certificates are an important component. Management of these certificates is also possible with contract models for Guarantees of Origin and European Emission Allowances (EUA). A high degree of automation and integration into short-term trading complement the integration of renewables in the form of PPA. ◉

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The PSI blog features more interesting and in-depth articles on production, logistics, AI, energy and mobility.

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