



*Gas Management Suite
Smart Operation and
Management of
Gas Grids and Storage*

PSI 

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Introduction

The PSI Gas Management Suite (PSI GMS) is a field-proven suite of applications which are used to operate technical gas grids and storage facilities and to handle commercial business processes. It is a standard, modular system solution for monitoring and control, analysis and

management. PSI GMS combines applications for forecasting, technical operation, simulation and commercial dispatching. All applications are based on current and future market requirements with respect to functionality and software technology.



PSI GMS includes functionality for

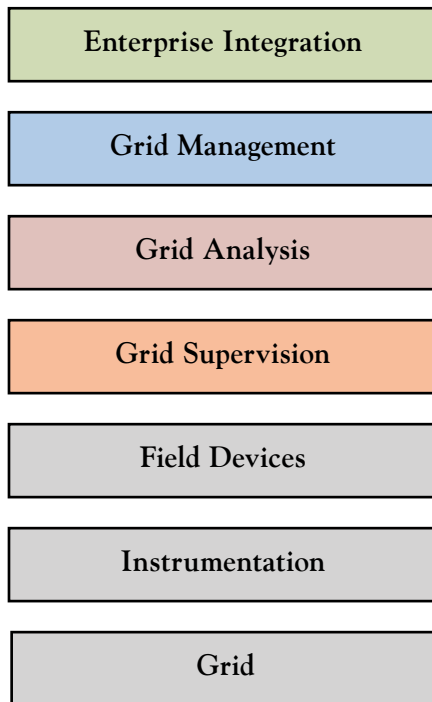
- Gas Transport
- Gas Storage
- Forecasting
- Simulation
- Maintenance
- Monitoring
- Control
- Historian
- Reporting

PSI GMS characteristics are

- Flexibility
- Modularity
- Scalability
- Reliability
- Safety
- Effectiveness

Integrated Solution

PSI GMS is fully integrated and is composed of perfectly matched applications which utilise software and hardware for cost-effective implementation, high system performance, high reliability, outstanding quality, efficient engineering, safe operations and reduced costs for services and training.



PSI GMS combines the grid supervisory application PSIconrol with the simulation application PSIGanesi and the gas grid and storage management application PSITransport. Additional applications for access authorisation, communication and reporting complete the solution.

PSI GMS is based on over 40 years' experience and implementation of numerous gas industry projects. The software is constantly evolving and represents the state of the art for modern, efficient and economical management of gas grids and storage.

The system fulfils highest security and reliability requirements. In each configuration the PSI GMS provides continuous high performance and fault tolerance. The modern and easy to use Graphical User Interface provides a consistent look-and-feel across all applications.

The modular design of PSI GMS ensures easy customisation for all kind of tasks.

PSI GMS's unique scalable architecture supports different levels of integration with third party applications across diverse operation environments.

Scalability and Flexibility

PSI GMS is a highly scalable solution which provides all applications that are needed for day-to-day operation. All applications of PSI GMS are built on top of a common set of subsystems including real-time database, data historian, event and alarm system, data validation, communication and data exchange, redundancy management with automatic fail-over functionality, user access authorisation and a graphical user interface with Windows look and feel and multi-language support.

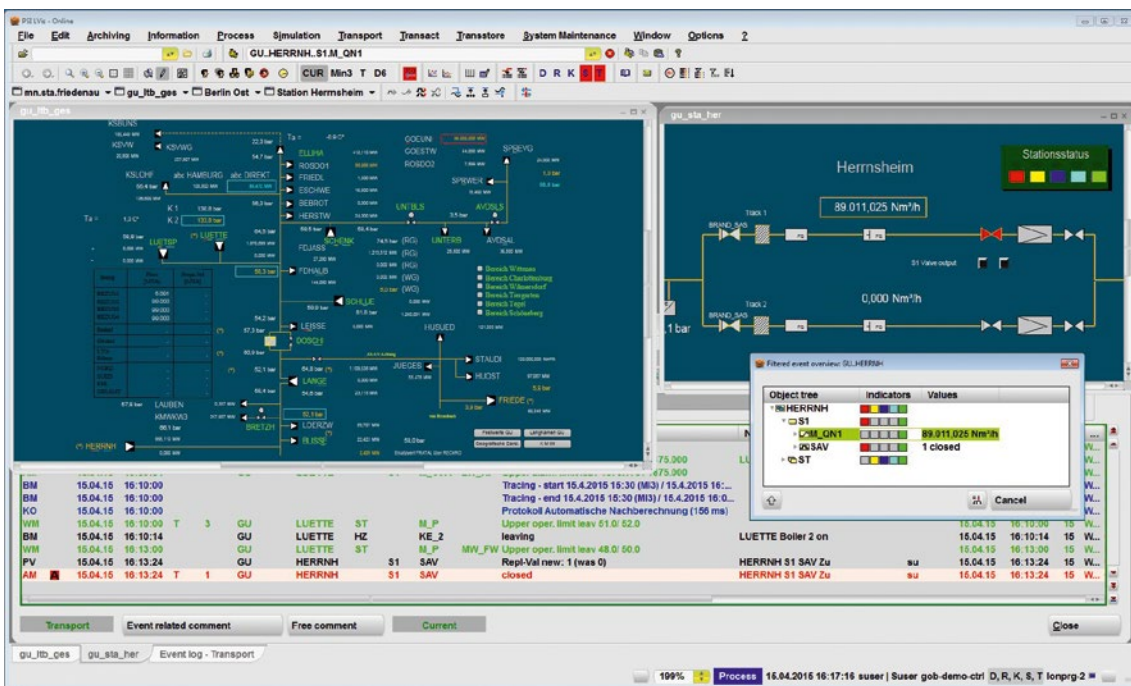
The inherent flexibility of the system ensures that an existing solution can expand to very large multilevel transport and distribution grids without project-specific code changes. In order to support maximum flexibility, scalability and efficient project implementation, PSI's GMS provides all necessary engineering tools for master data configuration, graphical screen design, user management and other configuration tools.

The utilisation of the modular platform and engineering, development and service expertise enables PSI to be a strategic partner for customers to implement standard or tailor-made solutions.



Grid Supervision

PSIcontrol provides efficient monitoring and control for technical processes. It supports the operation of input, transport, storage and output of gas in large pipeline systems. Operators are able to handle these processes safely, continuously, economically and in compliance with customer contracts.



Data Acquisition

PSIcontrol provides standard interfaces with standard protocols to capture real-time data from the actuator-/sensor-level.

Data Validation

Data collected by PSIcontrol is validated in real time. The validation includes plausibility, origin, status and processing detail tests. They can be set individually for each object.

Data Processing

Data that is adopted and tested by PSIcontrol will be processed further according to defined rules. The processing functions include analogue and Boolean monitoring, calculation functions, data compression and control.

Data Storage

Field data and processed data are stored in the real-time database. This database contains the current state of the process.

Data Historian

The integrated Data Historian stores all data collected by GMS applications, providing complete data records for gas grid and storage operations. The Data Historian provides a variety of data management tools for analysis and optimisation.

Visualisation

Visualisation is the central interface for human-process communication. Process and system states are shown by process displays, trend curves, data sheets, logs and alarm information. Commands and set points are used to control the grid and storage.

Automation

In addition to process monitoring and control functions carried out by the operator, control tasks can be fully automatic and continuous through use of calculation rules.

Alarms

The alarm log is used to display important events which prompt the operator to react appropriately.

Event Processing

PSIcontrol's event log is a very efficient tool that provides a quick overview of the entire process. It stores all important process events as well as all relevant operator actions.

Access Authorisation

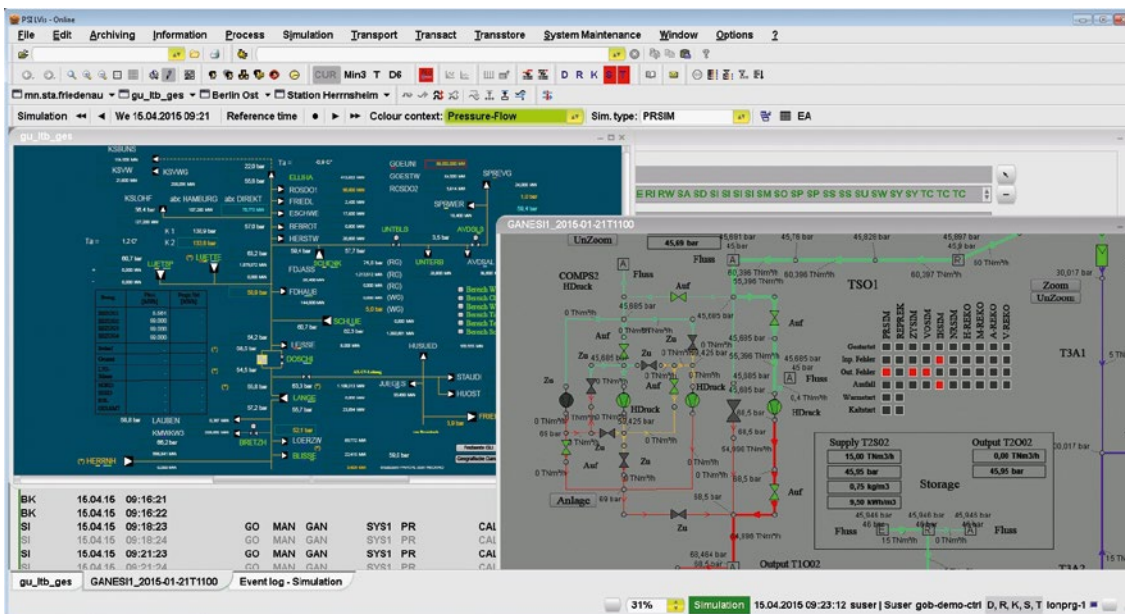
Access authorisation supports the management of individual user permissions to access process objects, system displays and application functions.

System Configuration

PSIcontrol provides a complete set of configuration and engineering tools for e.g. master data, process displays, calculation scripts and pipeline simulations.

Grid Analysis

PSI GMS provides sophisticated analysis tools for gas grids. The monitoring and control of the gas grid will be optimised and more secure through use of forecasting, simulation, maintenance and disturbance handling.



PSIganesi is a simulation system which provides a complete insight to the gas grids behavior and future, especially in areas where measurements are not available.

The system provides the following simulation modes:

- Real-Time Simulation
- Look-Ahead Simulation
- What-If Simulation

Real-Time Simulation

The PSIganesi Real-Time Simulation estimates the current process state taking pressure, flow, gas composition and temperature into account. Simulation results are checked continuously. All information including alarms and warning messages is logged and displayed.

Look-Ahead Simulation

A preselected operation mode might become inappropriate. The PSIGanesi Look-Ahead Simulation module identifies any negative drift to undesirable conditions in advance. The system detects the process element that is going to reach a certain threshold and calculates the exact time when the event will occur. The operator can then adjust control or switch operations. A Look-Ahead simulation runs on a cyclical basis.

What-If Simulation

In gas grid operations it is essential to know in advance the consequences of operator-initiated actions. Based on real-time simulation, valve settings, modified set points and other information PSIGanesi What-If Simulation calculates the corresponding future process values. Multiple scenarios can be evaluated.

PSIGanesi includes the following application modules:

- Property Tracking
- Scraper Tracking
- Velocity Monitoring
- Fuel Gas Calculation
- Real-Time Simulation
- What-If Simulation

- Look-Ahead Simulation
- Leak Detection and Localisation
- Hydraulic Profiles

Forecasting

PSIprognose is used to estimate gas consumption. It incorporates different methods taking into account weather forecasts or periodic behaviour. The mathematical models utilise calendars, different temperature areas and contract conditions. Based on Kalman filtering, exponential smoothing and trend corrections the system is self-learning. The models are initialised with historical data. The forecaster can use all data objects from GMS applications or third-party systems.

The following methods are provided to predict gas consumption:

- Regression Analysis
- Time Series
- Extrapolation Method
- Load Profile

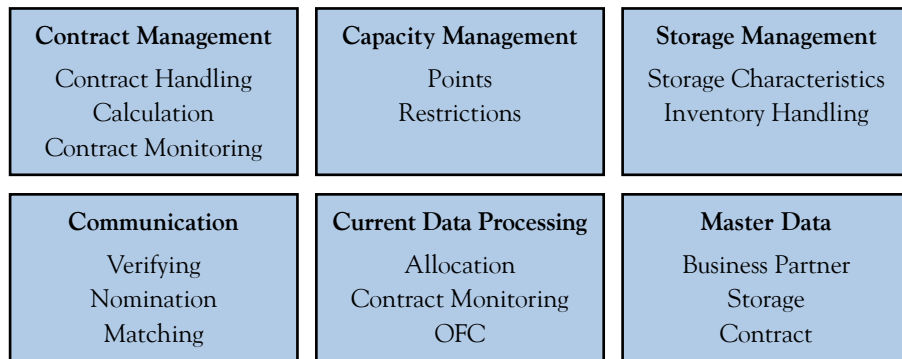
Maintenance and Disturbance Analysis

Based on historical data and future planning the system provides several tools to detect and to analyse current or future improper operational situations.

Grid Management

The Grid Management function is mainly comprised of logistical and dispositional tasks. These tasks can be of a technically oriented nature and/or of a more commercially oriented nature. Grid Management in the technology-oriented area is based on the physical conditions. The quantities and qualities at the input and output points are planned based on the transport capacities and the commercial constraints.

Capacity Management provides for the booking and combination of capacities for the subsequent execution of the business. It handles firm and interruptible capacities. The functionality for contract handling together with contract monitoring provides for an efficient execution of contracts. Communication including nomination handling, like matching, can be defined as flexibly as the business processes require. Any re-



Transport and Storage Logistics

PSItransport is a gas transport and storage management application which provides the necessary functions to manage business for integrated companies, TSOs and SSOs. The system serves as a central management console for gas logistics, contract management, capacity management, inventory management, business partner management, communication, reporting and master data management.

sultant aggregation will be used to support scheduling in operations. Storage facilities are represented by their characteristic behaviour and their inventory. Balancing and allocation with current values provides necessary information for market partners and billing purposes. A standard and flexible definition of master data facilitates the appropriate representation of business process objects.

Enterprise Integration

For the purposes of company management the PSI GMS can be seamlessly integrated into the existing enterprise infrastructure and provides all necessary data for upper management decisions. PSI GMS is integrated in the most secure way.

Security of Operation

PSI GMS uses standard IT components and proven network technologies. It is a fault-tolerant system and ensures highest component availability for continuous operations.

Cyber-Security

IT-specific risks must be eliminated or reduced as far as possible. It is well known that network and internet connections are vulnerable to viruses, trojans and hacker attacks. Therefore in PSI GMS safety risks are minimised by the following measures:

- Access points are kept to a minimum number and are restricted
- Highly segmented network infrastructure through use of firewalls
- Limited usage of operational systems and third party software
- Secure authentication processes
- Inbuilt robustness against attacks

Reliability

The PSI GMS has been designed for 24/7 operations in mission critical environments.

Portal for business reporting

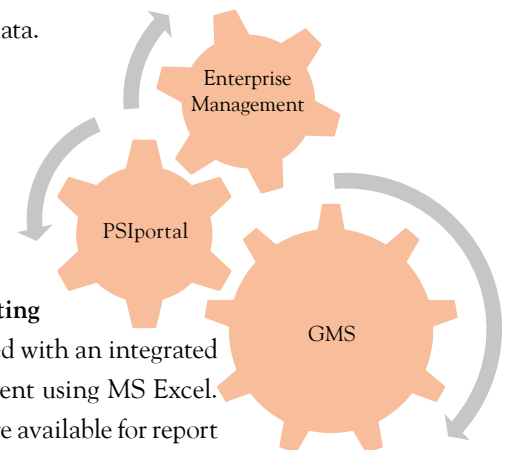
PSIportal is an application which supports the information flow and the information representation of all kinds of data for internal and external use. PSI and third party applications' data is stored in PSIportal. The data is accessible via a web-based graphical user interface which allows representation of this data in table or diagram formats; to generate reports which can be sent automatically to predefined recipients; or to exchange data in standard formats with third party applications. The flexible web-based reporting solution can incorporate master data, measured values and calculated values. The system maintains an audit trail for the lifecycle of the data.

Operational Reporting

PSI GMS is delivered with an integrated reporting environment using MS Excel. All Excel features are available for report composition. Reports can be printed, emailed and stored.

Interfaces

Flexible communication interfaces provide data and reporting connection to in-house applications and employees. PSIcomCentre manages the business communication via automated protocols to business partners



Engineering, Training and Support

Engineering

System Design, Project Management, Engineering, Test and Commissioning include:

- Project organisation and resource management
- Preparation and management of reviews and meetings,
- Project schedule supervision,
- Quality control,



- Preparation of System Design Documents,
- Hardware setup and configuration,
- Software setup and configuration,
- Tests and Model tuning,
- Preparation and execution of commissioning and tests,
- Preparation of user manuals.

Training

Training courses for operators, system administrators and maintenance personnel include:

- PSI GMS overview
- PSI GMS data visualisation and human machine interface
- PSI GMS applications,
- System and engineering tools

Support

PSI provides maintenance services for PSI GMS software after project acceptance. Depending on customer and operational requirements the following services are provided:

- 24/7 support and operational services
- Reference installation in PSI facilities,
- Services to correct detected faults and application support,
- Preventive maintenance and system management,
- Services at the client's request (e.g. changes and adaptations of software and configuration)
- Customer specific services and developments.

Company

PSI develops and integrates software solutions and complete systems for liquid and gas pipelines, electricity networks, manufacturing plants and public transportation.

From the very beginning PSI's business focus has been clearly defined: Close cooperation with its customers. The key to success lies in a comprehensive understanding of customers' core business processes. This enables PSI to deliver intelligent, high-tech solutions today whilst developing technical innovations that will shape the future. The company was founded in 1969 and currently employs 1,620 individuals in eleven German and fifteen international locations in Europe, North and South America, The Middle East and Asia. In financial year 2016 the Group achieved revenues of 176,9 million Euros. The PSI Software AG is listed in the Prime Standard of the German stock exchange.

Quality Management

PSI has a policy of constant development and improvement of its products and has a formal quality management system that was first certified to be in compliance with ISO9001 in 1994. The quality management system is re-certified every three years.



References

Company	Country	Project	Scope of Supply
AGGM AG	Austria	Gas Grid	PSIcontrol Gas, PSItransport, PSIcomcentre
Avacon AG	Germany	Gas Grid	PSIcontrol Gas, PSItransport, PSIcomcentre PSIganesi, PSIganproda
Bayer MaterialSciences Co., Ltd.	China	Supply Management	PSIcontrol Gas – Load management system
caplog-x GmbH	Germany	Gas Grid	PSIcontrol Gas, PSItransport, PSIcomcentre
DONG Energy A/S	Denmark	Gas Trade	PSIgasaf, PSItransact, PSIcomcentre
Energie Steiermark AG	Austria	Gas Grid	PSIcontrol Gas, PSItransport, PSIcomcentre
E.ON Global Commodities GmbH	Germany	Gas Trade	PSIcontrol Gas, PSItransact, PSIcomcentre
E.ON Gas Storage GmbH	Germany	Gas Storage	PSIcontrol Gas, PSItransstore, PSIcomcentre, PSIportal
Erdgas Münster GmbH	Germany	Gas Grid	PSIcontrol Gas, PSIganesi
GASCADE Gastransport GmbH	Germany	Gas Grid	PSIcontrol Gas, PSItransport, PSIcomcentre, PSIganesi
Gasunie Deutschland GmbH	Germany	Gas Grid	PSIcontrol Gas, PSItransport, PSIganesi, PSIganproda
Gazprom	Russia	Gas Storage	PSIcontrol Gas, PSItransstore, PSIcomcentre, PSIportal
Gazprom	Russia	Gas Transport - Nord Stream onshore - Ukhta-Bovanenkovo - Sakhalin-Vladivostok - Modernization Transgaz S. Petersburg and Transgaz Ukhta - Control Dispatching Center Moscow	PSIcontrol Gas, PSItransport, PSIcomcentre, PSIganesi

Company	Country	Project	Scope of Supply
Gazprom	Russia	Gas Transport Blue stream onshore	PSIganos
HanseWerk AG	Germany	Gas Grid	PSIcontrol Gas, PSItransport, PSIcomcentre
Kommunale Gasspeichergesellschaft Epe mbH & Co. KG	Germany	Gas Storage	PSIcontrol Gas, PSItransstore, PSIcomcentre
NBB Netzgesellschaft Berlin- Brandenburg mbH & Co. KG	Germany	Gas Grid	PSIcontrol Gas, PSIganesi
ONTRAS Gastransport GmbH	Germany	Gas Grid	PSIcontrol Gas, PSIganesi
Open Grid Europe GmbH	Germany	Gas Grid	PSIcontrol Gas, PSItransport, PSIcomcentre Simulation and Gas property tracking
terranets bw GmbH	Germany	Gas Grid	PSIcontrol Gas, PSIganesi, PSIganproda
Thyssengas GmbH	Germany	Gas Grid	PSIcontrol Gas, PSItransport, PSIcomcentre, PSIportal, PSIganproda
Transport et Infrastructures Gaz de France S.A.	France	Gas Grid	PSIcontrol Gas, PSIganesi
VNG Gasspeicher GmbH	Germany	Gas Storage	PSIcontrol Gas
Westnetz GmbH	Germany	Gas Grid	PSIcontrol Gas, PSItransport, PSIcomcentre

PSIcomcentre – Communication system

PSIcontrol Gas – Control system

PSIganesi – Simulation system/Gas property tracking

PSIganproda – Gas property tracking

PSIgasaf – Application framework

PSIportal – Portal for business reporting

PSItransact – Commercial dispatching system

PSItransport – Transport management system

PSItransstore – Storage management system



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