Substation automation systems

PSGuard wide area monitoring system
Guarding the future electrical grid
Many of today’s electrical grids are being operated closer and closer to their limits. The increasing demand for electricity combined with an aging infrastructure, a growing trend towards the integration of distributed and renewable energy resources, and complex power exchange based on electricity trading markets have resulted in power systems being operated closer to their stability limits. These trends present an important challenge to the reliability of the future electrical grid.

ABB’s PSGuard Wide Area Monitoring system (WAMS) is a cornerstone technology to improve the visibility and situational awareness in both today’s and the future electrical grids. PSGuard collects, stores, transmits and analyzes critical data from key points across the power networks and over large geographical areas. Its state-of-the-art portfolio of Wide Area Monitoring applications is designed to detect abnormal system conditions and evaluate large area disturbances in order to preserve system integrity and maintain acceptable power system performance.

Highlights of ABB’s PSGuard
- Proven suite of advanced WAMS applications
- Scalable server-client architecture and functionality for a wide range of applications and step-wise introduction
- Supports IEEE C37.118 compliant PMUs
- Powerful data storage and export capabilities for archiving of historical data and export to external applications
- Integration into platform-independent SCADA/EMS systems
- Modern and intuitive HMI provide the operator with real-time information of the power system status
- Flexible data exchange to other utilities and external partners
- Standard and open connectivity through OPC interfaces ensure interoperable solutions
Key benefits of PSGuard wide area monitoring system

PSGuard is designed to detect incipient abnormal system conditions, alert the network operator of dangerous disturbances as they evolve and to provide the information required to preserve system integrity and ascertain power system performance.

**Improved power system operation**
The operators are additionally provided with online information on the power system status at the right time.

**Better use of existing equipment**
The online information on the current power system status (e.g. remaining transmission capacity) allows transmission lines to be operated closer to the safety limits. Therefore, more power can be transmitted over existing transmission lines and the construction of new lines can be deferred.

**Increased power transmission capacity**
Instability limits that are calculated online permit an increase in transmission capacity for power transmission lines while maintaining the same level of security. The additional transmission capacity can increase profitability.

**Optimized power flow**
The continuous monitoring of the power system stability margins provides valuable information that can be used for the optimization of the power flow in transmission corridors in cooperation with other control equipment (FACTS, SVC, etc.).

**Lowered risks of power system instabilities**
Early recognition of incipient power system instabilities allows counter measures to be initiated early, so that the spreading of large area disturbances can be prevented. This helps to significantly reduce the costs caused by outages.

**Improved power system planning**
Enhanced knowledge about the dynamic power system behavior enables countermeasures to be prepared more precisely, and provides improved data for the planning of system extensions.

**Future-proof interoperable design**
ABB’s commitment to the implementation of standard and open solutions for communication in Wide Area Systems creates future proof and interoperable solutions.
PSGuard wide area monitoring
Scalable architecture and functionality for your needs

The architecture of the PSGuard system provides a scalable solution, which is suitable for a wide range of customer requirements ranking from small installations for data collection and basic visualization to larger systems with intelligent monitoring using wide area applications. PSGuard solutions are based on standard and open architectures, allowing for optimal data sharing and enabling the system to be extended to meet future requirements of the power system.

PSG830 Wide Area Measurement
The PSG830 provides wide area measurement and phasor data viewing. The PSG830 enables integration of existing or newly installed PMUs into a wide area monitoring system which provides phasor data at a central location. It is the basic platform for wide area solutions enabling power utilities to introduce WAMS technology stepwise with minimal investment. The PSG830 provides the operator with the system supervision displays, trends and event and alarm lists.

The package includes
- Connectivity
- Basic monitoring
- Data storage and export
- Phase angle monitoring

Optional the following modules are available
- Event driven data archiving
- Communication gateway to partner TSOs
- Interface manager for SCADA integration

PSG850 Wide Area Monitoring
The PSG850 provides advanced wide area monitoring applications for the detection and analysis of various instabilities in power systems. Each application module can be configured to guard key sections of the power system. Applications can also be introduced step-wise in the system, depending on the utility’s needs.

The PSG850 also provides a communication gateway to exchange data with other utilities or external partners, as well as an interface module for SCADA integration.

An advanced graphical display provides the operator with an intuitive navigation of the power system using the utility’s single line diagram, system supervision display and application faceplates.

The package includes
- Connectivity
- Basic monitoring
- Data storage and export
- Phase angle monitoring

Optional the following modules are available
- Event driven data archiving
- Line thermal monitoring
- Voltage stability monitoring
- Power oscillation monitoring
- Power damping monitoring
- Communication gateway to partner TSOs
- Interface manager for SCADA integration
Solutions overview

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<td>Data storage and export</td>
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<td>Phase angle monitoring</td>
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<tr>
<td>Communication gateway to utility partners and TSO</td>
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| Recommended application                      |         |         |
| Substation PDC / gateway                     | ●       | ●       |
| Station PDC                                  | ●       | ●       |
PSGuard functionality
Basic monitoring applications

The PSGuard operator workplace provides powerful views of the wide area system, allowing the system operator to easily and quickly identify network disturbances in real time as well as evaluate past events for post-mortem analysis.

System Supervision
The PSGuard System Supervision enables the operator to navigate to Phasor Measurement Units (PMUs) directly and provides all of the necessary information to supervise the condition of the PMU. The PMU status, communication status as well as GPS synchronization can be viewed at a glance.

Dynamic Trend Display
The PSGuard trend display enables operators to observe the development of events in real time. The trend display offers access to historical data and can be selected for all elements in the system. Standard functions of PSGuard trends include:

- Individual axis scaling
- Adjustable time scope
- Online integration of new traces
- Zooming, time and value rulers, etc.

Trend views are available for all PSGuard application outputs as well as raw measurement values. Which means that every measured and every calculated value can be analysed and compared visually over long time spans, both in real-time or offline.

Events and Alarms
PSGuard provides notifications through its integrated Events and Alarms pane. User defined events and alarms provide the operator with the information needed to react immediately to events in the system.

Single Line Display
The PSGuard single-line representation provides the operator with an overview of the power system, including complete access to the Wide Area Monitoring information in his network using easy-to-understand symbols and buttons to access detailed information in the system.
Connectivity and communication applications

Connectivity
The PSGuard Connectivity module provides the data link to Phasor Measurement Units (PMUs) using standardized protocols. The data is made available to other PSGuard applications and is easily integrated into other control systems. Furthermore, the Connectivity module provides watch-dog functionality and supervises the communication channels as well as the GPS synchronization of the PMUs in real time.

- Support for IEEE1344-1995 and IEEE C37.118 compliant PMUs
- Data transmitted over OPC Data Access (DA) Standard Interface.
- Serial (RS232) and network (TCP/IP) links to PMUs are supported

Communication Gateway
The PSGuard Communication Gateway enables Transmission System Operators to exchange PMU data with other utilities. The Communication Gateway features the following benefits:

- One central PMU data access point for other utilities instead of connecting the devices to a common network.
- Control of access rights to the data.
- Control of data that is provided to other utilities by selectable transmission of PMU signals to the clients. For example signals like voltages can be included and restricted data like currents can be excluded from the data exchange.
- Control of update rates for each client to optimize communication bandwidth.

Data Storage and Export
Data Storage is a key function of the PSGuard system to archive historical process data from PMU devices and Wide Area Monitoring applications. Data sets can be stored in different resolutions and various time spans. Connections to local as well as remote History Data Access (HDA) servers are supported, enabling a flexible and expandable architecture. The PSGuard Data Export provides the functionality to export data from the history database to external applications, including comma separated value files (CSV), allowing further processing and analysis of the datasets using these applications.

Interface Manager
The PSGuard Interface Manager provides operators with PMU measurements, WAMS application data and alarms from PSGuard in their SCADA/EMS systems. This PSGuard interface is platform independent and enables data access from different SCADA/EMS systems. When connecting PSGuard with a Network Control Center (NCC), these systems regard PSGuard as a gateway device, which enables easy and fast integration.

The Interface Manager provides data to SCADA/EMS with an update rate that can be configured down to the supported update rate of the SCADA/EMS system.
PSGuard functionality
Advanced wide area monitoring applications

Event Driven Data Archiving
The PSGuard Event Driven Data Archiving application (EDDA) forms the Wide Area transient and disturbance recorder. It can record system wide disturbances in a power grid and flexibly captures event related PSGuard high resolution data in an archive. This archive contains the range of data before and after the detected event to ensure that really all necessary data leading to an event was recorded. The archiving times can be configured flexibly by the operator.

Phase Angle Monitoring
The Phase Angle Monitoring (PAM) application facilitates the monitoring of network stresses caused by heavily loaded lines. It provides operators with real-time information about voltage phase angle deviations between two locations. This is, for example, a decisive factor for the successful reclosing of transmission lines. PAM helps utilities to improve the voltage control of their power system. This application makes it possible for utilities to safely operate power-carrying components closer to their design limits, without jeopardizing stability, security or reliability.

Line Thermal Monitoring
Due to the high cost of new transmission circuits as well as transmission bottlenecks, the static thermal ratings of transmission lines are now being challenged by many utilities as overly conservative. As an alternative, ABB offers utilities an application of real time thermal rating of the transmission lines as an option to access and increase the available transfer capability of the transmission circuits. The Line Thermal Monitoring (LTM) application provides accurate information about thermal conditions of the transmission circuit. Dynamic rating of a transmission line is considered to be a smart cost alternative to the addition of a new transmission line without risking the thermal overheating of an existing transmission line.
Voltage Stability Monitoring
The Voltage Stability Monitoring (VSM) application provides power system operators with valuable online information to assess the present power margin with respect to voltage stability. A power margin is the amount of additional active power that can be transported on a transmission corridor without jeopardizing voltage stability. This monitoring functionality and its outputs are intended as decision support for operators. Actions the operator may take to improve voltage stability may range from generation rescheduling or actions on the reactive compensation, blocking of tap changers in the load area or in extreme cases load shedding. The VSM application is designed to monitor transmission corridors and it therefore delivers the dynamic current and voltage phasors and resulting calculations in real time.

Power Oscillation Monitoring
Power Oscillation Monitoring (POM) is a PSGuard application used for the detection of power swings in a high voltage power system. POM gives the operating personal an immediate awareness of the power system state in terms of oscillations, so that operators will see the urgency of the situation more quickly. The POM algorithm processes the selected voltage and current phasor inputs and detects the various power swing modes, which can e.g. lead to angular instability causing disturbances. POM quickly identifies the frequency and the damping of swing modes and provides improved power system visibility.

Power Damping Monitoring
The damping of inter-area oscillations is a major concern for many power system operators today. Consequently, the detection and characterization of such oscillations has become an important application area of wide area monitoring systems. The PSGuard Power Damping Monitoring (PDM) application utilizes a new method for the detection and characterization of oscillations using real-time synchronized measurements from multiple points in the power system. PDM can detect and characterize the damping behavior of oscillating modes using measurements during ambient conditions, thereby providing the operator with an effective early warning system before a disturbance in the power system triggers instability in such modes. Moreover, PDM characterizes the level of activity of each mode at the various measurement points, which allows the power system operator to identify which components of the power grid are participating in the oscillation.
Wide area monitoring system
System overview
WAM solutions from ABB
Experience that counts

With ABB’s unrivalled expertise, technologies and global experience in power systems, you can be sure to get the best-in-class solutions for your applications.

Competent service and support in all project phases
With a full scope of services and global support network in more than 100 countries, ABB can enable you to reap the full benefits of your investment throughout the system lifetime.

– System design specification
– Engineering, system integration and commissioning services
– Factory acceptance tests
– Customer training
– Service and support contracts