



SIEMENS

Ingenuity for life



Always an eye
on security

SIGUARD solutions – improving the
supply reliability of your power grid

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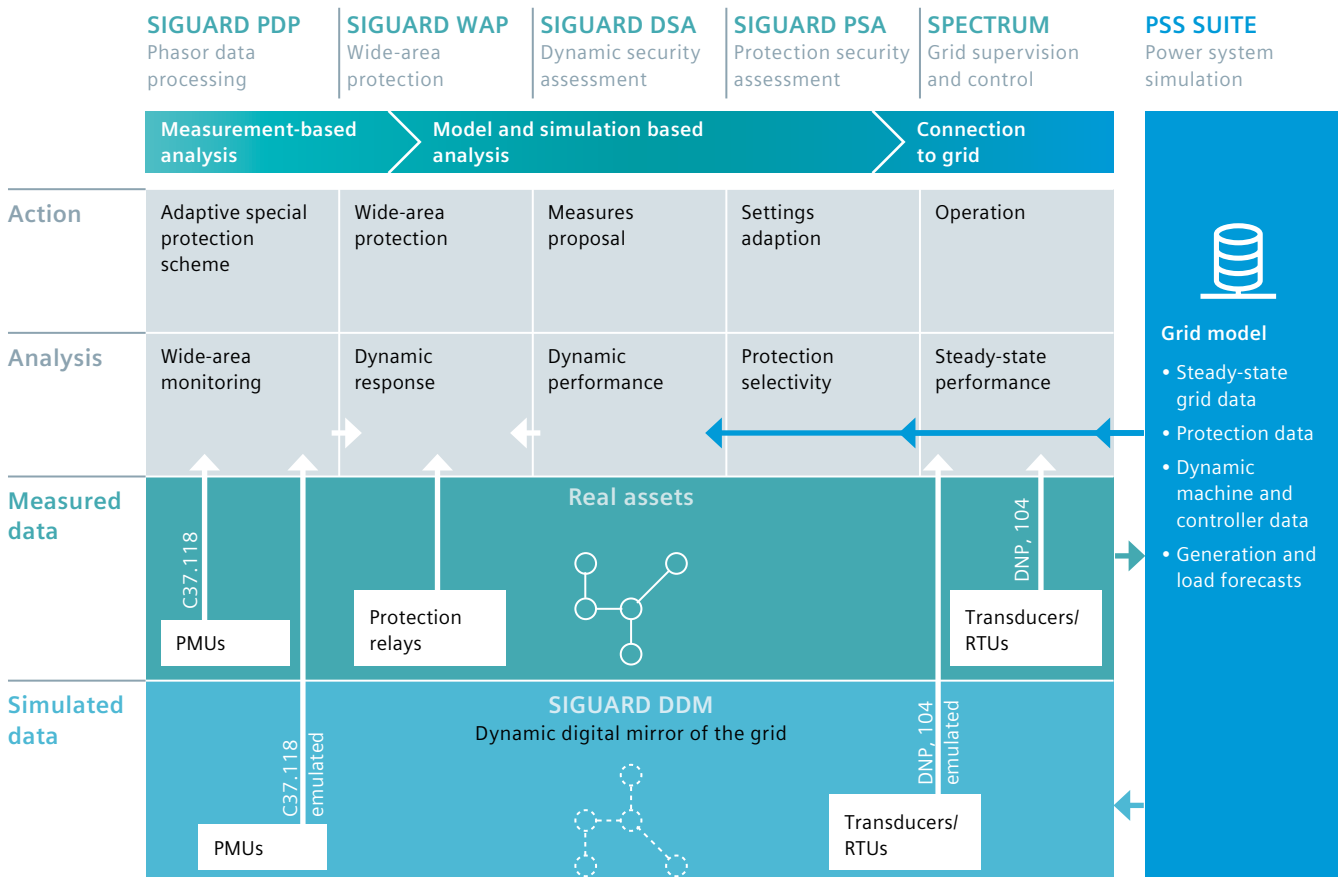
Keeping an overview

SIGUARD® is a suite of innovative software solutions from Siemens that helps ensure a reliable power supply at all times. System operators benefit from the software solutions' support in making the right decisions. This support facilitates the optimum use of all assets and can lead to the prevention of unnecessary trippings and blackouts. In addition to that, the workload for strategic and day-ahead system planning can be reduced noticeably thanks to intelligent result evaluation and aggregation. SIGUARD comprises five solutions that can be used together as well as independently of each other.

- SIGUARD DSA (dynamic security assessment) analyzes possible contingencies and assesses the system stability. It provides the operator with an overview of the current and near-future state of system stability.

- SIGUARD PSA (protection security assessment) analyzes the selectivity, sensitivity, and speed of the entire protection system for various fault scenarios on system buses and branches. It enables a rigorous protection system performance audit on a regular basis or prior to switching events.
- SIGUARD PDP (phasor data processor) uses phasor measurement units (PMUs) to observe the actual state of the power system. It monitors system variables and informs about critical system states.
- SIGUARD DDM (dynamic digital mirror) is the digital twin of the power system for dynamic analyses.

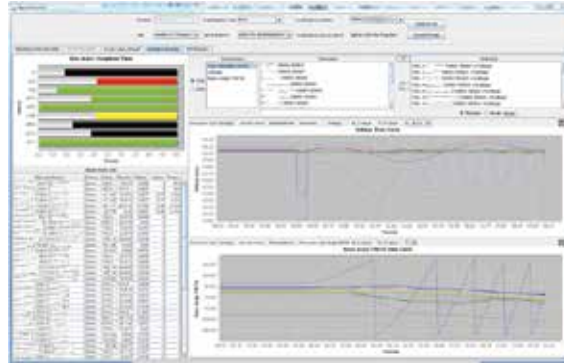
The SIGUARD family will soon be completed by SIGUARD WAP (wide-area protection), which provides system integrity by fast actions based on pre-simulated and verified actions.



Dynamic security assessment with SIGUARD DSA



Cockpit as high-level visualization in the control room.



Expert view with time curves and index values for each system element.

Today's challenges in transmission power system operation demand a closer look at power system stability. In many situations, the thermal (static) limits are way beyond the stability limits which cannot be directly measured. Consequently, network operation cannot solely rely on data acquisition and static n-1 analyses. To support the control room personnel, the margin to instability must be determined continuously and foresightedly, and remedial measures must be proposed to the operator as early as possible.

Dynamic security assessment

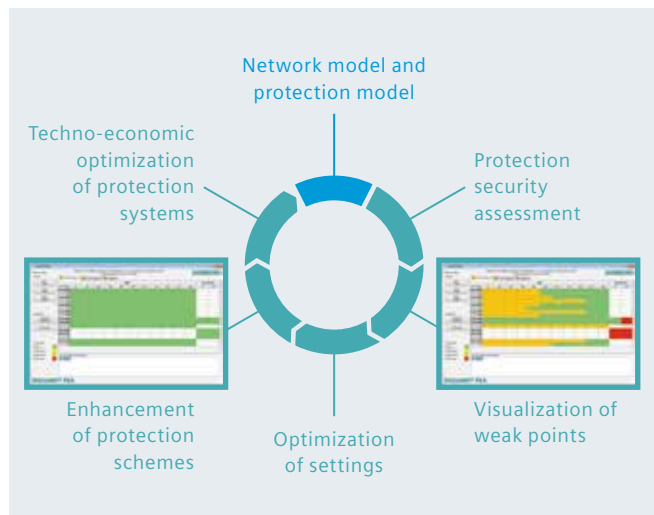
SIGUARD DSA uses the dynamic simulation engines of the PSS® Suite to assess the degree of stability in real time, for short-term planning as well as long-term planning. It combines the real-time information from SCADA/EMS systems with the dynamic models available in the asset management or system planning department in order to provide a consistent simulation model for voltage stability, transient stability, and small signal stability studies. With this simulation model, SIGUARD DSA performs a totally automated contingency analysis. It offers a very simple and catchy visualization of the results and provides recommendations for operators as well as very detailed information for dynamic experts in the back office.

The solution includes customization and integration of SIGUARD DSA into any IT environment. Siemens also offers the adaptation and long-term maintenance of the power system model as well as related consulting services.

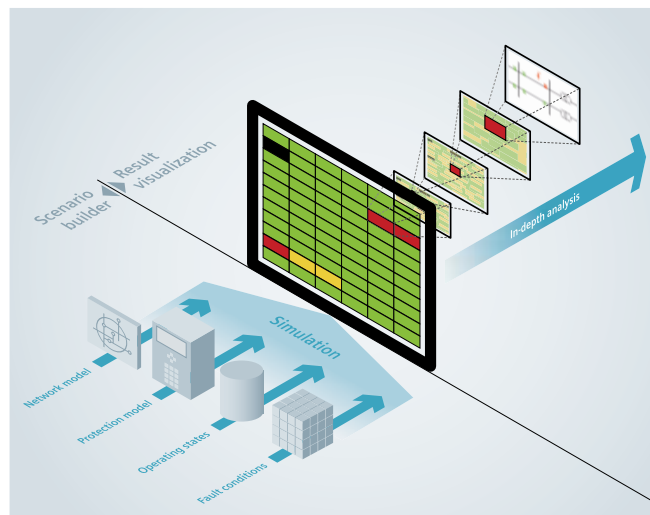
Highlights

- Increased system security and utilization
- Distributed architecture and parallel computing for highest performance
- No limitations in degree of modeling detail
- Customizable stability analysis procedures
- Early recognition of stability problems and proposal of verified remedial actions
- Visualization of results from high level to high detail
- Platform independent, multi-user ability, Web applicability
- Compliance with global cyber security standards, such as NERC CIP
- Meets control room requirements (security, redundancy)

Protection security assessment with SIGUARD PSA



Continuous system-wide assessment of the performance of the protection system.



From scenario overview to in-depth analysis.

Protection systems are crucial for system security because they limit the impact of faults on power systems. Continuously evolving power systems and quickly changing operating conditions make it a complex task to calculate, verify, and validate protection settings. Rigorous protection security assessment that takes into account all relevant network, operating, and fault conditions is required to review the adequacy of protection settings. Such protection security assessments should be carried out at regular intervals and only automated solutions can manage them efficiently.

Protection security assessment

The SIGUARD PSA solution comprises:

- Network and protection data management (including data collection and update)
- Network and protection simulation using core engines from the PSS suite or the customer's software
- Protection security assessment, such as the detection of non-selectivity and of hidden as well as critical faults
- Online result visualization and documentation
- Protection-setting improvement

SIGUARD PSA enables protection engineers and power system operators to perform fast protection security assessments for reliable protection settings determination, secure system operation, and of cascading trippings prevention.

The solution includes customization for application in planning, operation, and training. Protection system audits and certification can also be offered as consulting services on a regular basis or after a major upgrade in network or protection system.

Highlights

- Concise and detailed depiction of protection system performance by fingerprint analysis in traffic light colors
- Relief from time-consuming simulation tasks
- Prevention of avoidable supply interruptions
- Identification of incorrect settings and limitations of the protection system
- Improvement and verification of new settings
- Offline planning as well as online operational application

Wide-area monitoring with SIGUARD PDP

SIGUARD PDP (phasor data processor) uses synchrophasors and facilitates the fast assessment of the current system status. It immediately indicates power swings as well as transients. This helps control center staff find the causes and take countermeasures.

Applications

- Analysis of the power flows in the system
- Power swing recognition
- Evaluation of power swing damping
- Monitoring of transmission corridor loads
- Island state detection
- Retrospective event analysis
- Alarms in case of limit-value transgression, including an alarm list and color changes on the geographic network overview map
- Display of the system status as a characteristic value for the power system stability

Synchrophasor technology

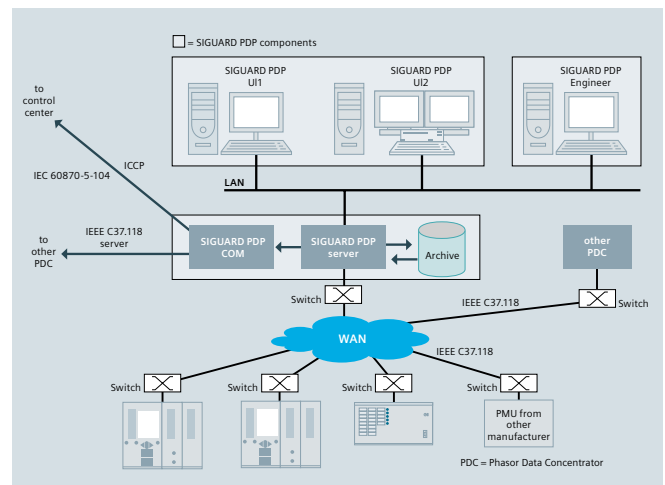
Synchrophasors are acquired by phasor measurement units (PMUs). This means that the magnitude as well as the phase of the current and the voltage are measured and transmitted. A time stamp is added to the transmitted phasor-measured values, allowing the comparison of values from various network locations when they are brought together at a central point. Synchrophasors provide a dynamic real-time view of power swings and other phenomena during network operation.

Highlights

- Online and offline mode for the analysis of past events
- Phasor view and time-chart view for all phasors
- Calculation and display of the Power System Status Curve
- System monitoring, including communications link and PMU status
- Geographic overview
- Basis for fast reporting after faults
- Flexible analysis with a formula editor for calculations based on measured values
- Limit values can be changed online
- Powerful automatic analysis: power swing recognition, island state detection, automatic disturbance recognition, limit violation



SIGUARD PDP UI map.



Structure of the SIGUARD phasor data processing system.

Digital twin of power grids for system dynamics – SIGUARD DDM

SIGUARD DDM is a dynamic power system simulator for real-time applications. It enables the simulation of electro-mechanical dynamics over time. Based on standard interfaces to control room applications, such as IEEE C37.118, IEC 60870-5-104, or DNP, it is very simple to set up a dynamic simulation or training system which utilizes the real SCADA/EMS or WAMS systems as the user interface while replacing the network by its digital twin.

Wide-area monitoring systems (WAMS)

WAMS allow for observation of sub-synchronous dynamics in power systems. Some of the analysis functions have to be parameterized in WAMS in order to be performed in real time. Additionally, it is very important to place the PMUs so that all network-specific phenomena can be observed. All of these tasks can only be performed with an adequate dynamic model of the power system.

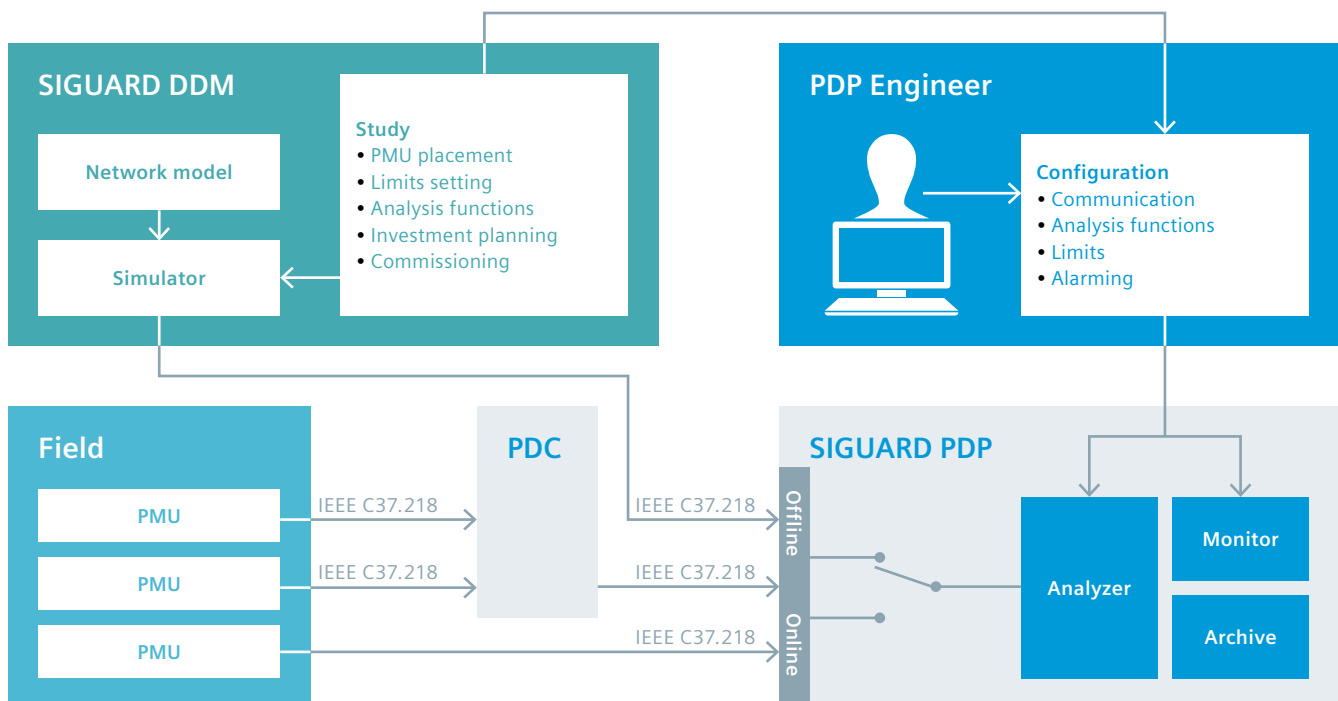
Applications

- Optimal PMU placement
- Setting of relevant WAMS analysis functions including limits setting
- Training of users in simulated environment
- Check of system response to switching or other network changes can be performed prior to operator action

Once the dynamic power system model is available for the DDM, it can be used for other purposes like dynamic stability assessment (e.g. with SIGUARD DSA). With the help of DSA it would be possible to also analyze potential contingencies that have not occurred yet, and hence cannot be measured by PMUs.

Highlights

- Standard interfaces to SCADA/EMS or WAMS
- Real-time analysis functions
- Decision support for investment planning
- Supports seamless commissioning
- Training simulator for personnel
- Simulation environment for further planning tasks
- Digital twin for online application



Application example for PMU placement studies and PMU training simulator.

Demonstrating the power of SIGUARD in the world's first dynamic grid control center real-world application



Autopilot for transmission grid operators: Siemens and research and scientific partners have opened a dynamic grid control center at the Technical University of Ilmenau, Germany, that is the first of its kind in the world.

Supported by the German government, the research project "DynaGrid Control Center" focuses on the transition of current control center hardware and software to a new generation. The next generation of control centers adapts to the new challenges of the decarbonized energy systems. This adaptation is achieved by an improved observability of the dynamics with SIGUARD PDP and the ability to master the stability issues with the help of foresighted analysis with SIGUARD DSA and PSA.

All SIGUARD products are used and further developed during this research project. A fully integrated control center running the whole bench of dynamic analytics, streaming analytics and protection assessment is available as a SIGUARD demonstrator.

The SIGUARD solution can be explored in a real-world environment. The dynamic simulation in the background provides the dynamic system response to any switching or controller interactions of the operator. Ideas and improvements can be addressed and implemented without the risk and the investment required in a user-owned "test control room."

Highlights

- Complete control room with two operator working places
- Fully running SCADA system (Spectrum Power)
- Fully running SIGUARD suite with all components
- Complete integration and interaction between SCADA and SIGUARD
- Dynamic simulation in the background

Hands-on experience

If you are interested in getting a more comprehensive view of the complete system, do not hesitate to contact us. You can visit the world's first dynamic control center and even get hands-on experience.

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