SIEMENS
Ingenuity for life

Spectrum Power™ transmission management

Intelligent control systems for a smarter future

siemens.com/spectrum-power

Spectrum Power™: transmission grid management at its best

Reliable and efficient operation

Intelligent and efficient power transmission is key to the highly reliable and safe supply of power. The operation of power transmission systems has never been more demanding. Many new stakeholders, new sources of energy, fluctuating demand, and new regulations need to be considered, while the grids need to be able to react to an increasing degree of volatility. The application of new, digitally driven solutions helps ensure stable grid operation under these new conditions.

Siemens has compiled a solution-oriented, integrated portfolio for transmission grid operators. It comprises products and solutions for efficient and reliable power supply with a focus on long-distance transmission, the grid integration of renewables, and strengthened grid stability.

Siemens Spectrum Power™ the fully integrated, customizable control center technology offers best-of-class applications for transmission management in energy networks of any size.

The Spectrum Power™ Energy Management System (EMS) provides versatile load flow optimization tools, helping operating staff to ensure reliable supply, the efficient use of generation resources, and reduced transmission losses in both real-time and operation planning phases.

Spectrum Power™ enables more reliable and secure real-time system operation by detecting faulty measurements. It highlights critical network areas and recommends preventive countermeasures by continuously running "what if" scenario simulations. QuickStab, SIGUARD® PDP (Phasor Data Processing), and SIGUARD® DSA (Dynamic Security Assessment) software helps ensure efficient blackout prevention with real-time and anticipatory monitoring of power system stability, alerting operators before a critical situation can occur.

Moreover, in response to the increased use of wind energy, the Spectrum Power™ WPM (Wind Power Management) package allows for power generation forecasts and load flow congestion management.

Spectrum Power™: the future-proof control center platform

Features	Benefits
Proven SOA capabilities	Enables seamless IT integration and easy extension in response to regulatory changes
Industry-leading in IT security	Provides protection against cyber attacks
Full CIM compatibility	Simplifies data exchange with pools and markets
Standard HW on x86 64-bit	Free choice supports your purchasing strategy
User-centered design	Optimized workflows and high level of situational awareness for secure supply
Online activation	Secure data engineering without interruption of the production system
Back-up configurations	Provides N-1 security up to control center level
Multi-site configurations	Flexible operation sharing and global overview of control centers with centralized data engineering

Experience and expertise

All-encompassing experience

Spectrum Power™ is the result of years of accumulated knowledge and experience in energy management. For the past three decades, Siemens has been supplying and developing SCADA (Supervisory Control and Data Acquisition) and EMS systems around the globe.

With over 3,000 control centers delivered worldwide, Spectrum Power™ represents field-proven technology. Siemens understands that contributing to its customers' success means more than just supplying a hardware and software platform. That's why Siemens is known for providing complete and comprehensive solutions, including:

- Engineering
- Configuration
- IT integration
- Training
- Maintenance
- Security services

In today's ever-changing world, where energy markets and trading aspects are in a state of flux, Siemens is unique in being able to effectively execute all phases of a project.

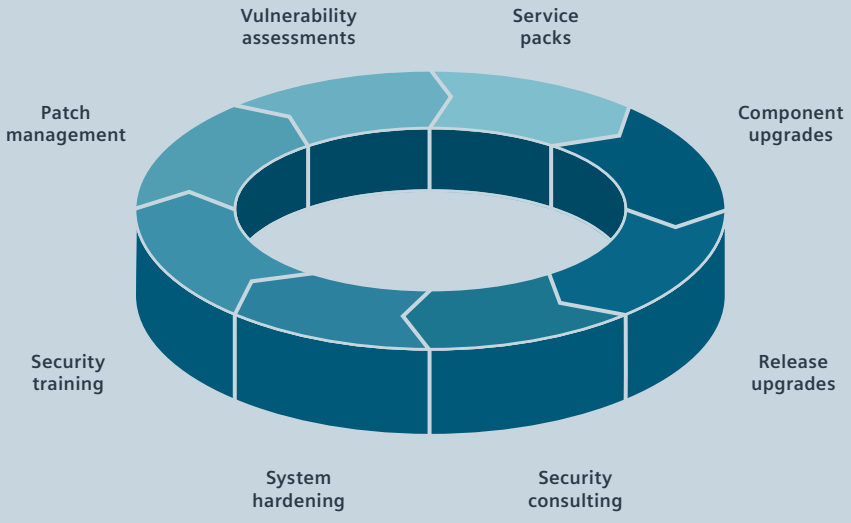
Global presence, local expertise

With its presence in more than 90 countries, Siemens is able to manage even the most demanding requirements of local projects. Customers from all over the world can rely on the company's expertise and a broad range of services that ensure reliable transmission grid operation around the clock.

Investing in a modern EMS increases long-term profitability while ensuring grid stability. With its fast and secure innovation cycles, Siemens consistently brings users new technology and caters to market requirements, covering everything from professional consulting on projects of any size to the configuration, installation and commissioning of complete systems.

Intelligent life cycle management ensures innovation and security

Protecting your investments



The EMS architecture for today …

All criteria met

Each Spectrum Power™ system is configured with the optimum number of web users and servers.
By distributing computationally intensive functions across several efficient servers, optimum reaction times are achieved for every system load. Critical functions are hosted on fully redundant, hot standby servers. Less critical functions are hosted on servers which employ a “spare” redundancy concept.

For the acquisition of field data, Spectrum Power™ provides a powerful communication front-end system supporting the communication with RTUs (Remote Terminal Units) of different manufacturers. A large variety of communication protocols are implemented, such as IEC 60870-5-101, IEC 60870-5-104, DNP 3.0 / DNP3.0i, and many more. Standardized protocols such as UCA/ICCP or ELCOM-90 provide a secure basis for reliable and fast data exchange with other control center systems.

Scalable, flexible and expandable

No matter what size or functionality is required, Spectrum Power™ can readily expand or adapt to any changes.
The Spectrum Power™ architecture can be scaled up or down to suit any network control system configuration – and with any combination of applications.

Straightforward configuration

The Spectrum Power™ GUI runs on any hardware platform, from multiscreen consoles to handhelds. The menu bar is freely configurable.

The network structure and its individual elements are graphically represented on a world map, with zooming, panning, and decluttering for fast orientation.
User guidance, including easy navigation between world maps, lists, and application windows also contributes to smooth and error-free operation.

Future-oriented architecture

Spectrum Power™ offers independence from hardware vendors by supporting the Linux operating system with 64-bit architecture. A broad choice of hardware provides flexibility for the utility’s purchasing strategy. Spectrum Power™ also adheres to the architectural paradigms of an SOA for easy and seamless integration into an existing IT landscape. This means investments in software and hardware retain their utility and value for many years to come.

… and tomorrow

Leading the next OT/IT revolution

Customized SCADA/EMS solutions are developed from a range of proven and innovative components – basic components of SCADA, communications, and data modeling, plus additional applications for grid optimization and generation management. Thanks to a service-oriented architecture (SOA), Spectrum Power™ is able to use other IT systems in a company – and these systems can, in turn, access the services of the grid control system. Standardized processes, interfaces, and messaging specifications based on the IEC 61968 and IEC 61970 standards support the trouble-free exchange of data between the systems.

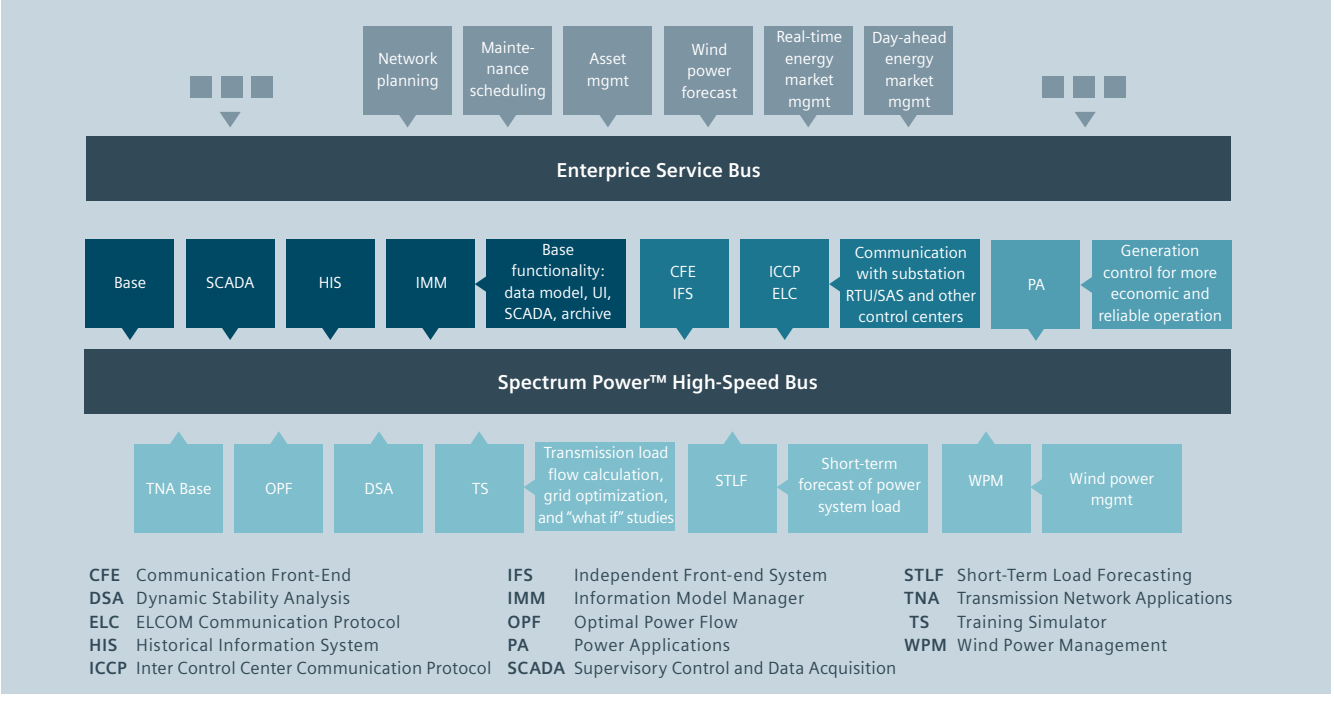
Multi-site – Flexible operation with centralized data engineering

The Spectrum Power™ multi-site operation capability provides a powerful tool, enabling the transfer of network management from one Spectrum Power™ control center to another. This allows for cooperative control of a power system – configurable from two or more control centers. This yields greater reliability of the control system (emergency strategies) and considerably reduces operational costs (overnight staff reduction, neighborhood support in emergencies). Centralized maintenance of a uniform data model for all multi-site control centers adds an all-time consistent database at a minimum cost.

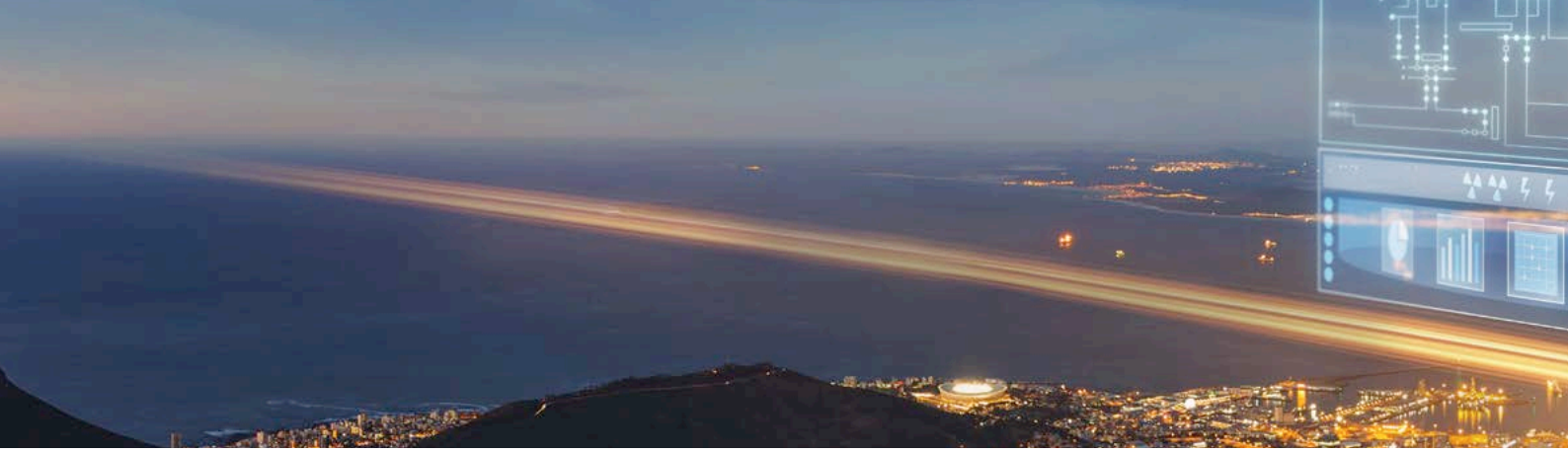
Safe integration of increasing renewable generation
The Wind Power Management (WPM) component efficiently and securely manages a transmission system that integrates wind energy resources. The Wind Power Forecast application forecasts the yield from wind plants based on meteorological and turbine availability data, and the Configurable Dispatch Engine distributes overall yield to help maintain system balance.

For monitoring steady-state and transient stability conditions, interfaces are linked to the Spectrum Power™ TNA (Transmission Network Applications) component and to SIGUARD® DSA respectively.

Finally, the Wind Generation Curtailment application provides dispatch instructions to maintain system reliability in case of excessive wind power generation. WPM is integrated with other components, whether internal or external SCADA/EMS, by means of web services in the framework of our service-oriented architecture.



CFE Communication Front-End
DSA Dynamic Stability Analysis
ELC ELCOM Communication Protocol
HIS Historical Information System
ICCP Inter Control Center Communication Protocol
IFS Independent Front-end System
IMM Information Model Manager
OPF Optimal Power Flow
PA Power Applications
SCADA Supervisory Control and Data Acquisition
STLF Short-Term Load Forecasting
TNA Transmission Network Applications
TS Training Simulator
WPM Wind Power Management



Specialized security …

Uncompromising cyber security

A major goal of Spectrum Power™ is to provide features and services that maximize customers' security while complying with all relevant regulatory requirements.

With its Spectrum Power™ Security Service, Siemens tracks security bulletins published by third-party vendors and other industry sources, installs and tests available security fixes on the latest Spectrum Power™ systems and components, and communicates all the results and known issues to its customers.

At the same time, each Spectrum Power™ system is delivered in a hardened state from the factory, with only the necessary ports open, and only the services and software installed that are needed.

Recognizing that cyber security requires an ongoing commitment, Siemens provides a comprehensive patch management service to licensed Spectrum Power™ owners. This includes patch notification, basic patch testing, up to and including optional custom services such as extended testing and on-site installation by Siemens technicians.
Siemens also provides a range of security consulting services, on-site security evaluations, and training.
A global service network is available to assist Spectrum Power™ owners through secure remote diagnosis and problem resolution.

Realistic training for confident operation

Efficient and secure transmission network operation needs qualified operators.
Spectrum Power™ Operator Training Simulator (OTS) replicates real-life power system scenarios to train operators to handle emergencies in a non-critical environment. The OTS has a user interface and application functions that are identical to the real-time system. The simulator presents results to the operators that are as realistic and accurate as those observed in real life. With an efficient web-based instructor environment and a comprehensive training scenario builder, the OTS enables training sessions when required, and allows power system operators to maintain a high level of operational readiness.

Information Model Manager – Highlights

- Considerable savings potential due to central data management
- Openness and interoperability for seamless integration into the Enterprise IT application environment
- Modern, user-friendly architecture
- SOA interfaces for easy integration via enterprise service bus (ESB)
- Standardized model and information exchange using CIM-XML/RDF format
- Multilevel security system to protect all data

… focused efficiency

Complete SCADA functionality

Secure, reliable and efficient network operation is ensured throughout the system thanks to:

- Fast navigation from problem to cause and between lists and diagrams
- Intuitive operation based on windows, menus, tooltips, toolbars, context menus and drag & drop
- Clear graphical indication of the current situation
- Efficient preparation and validation of switching operations via powerful switching procedure management

Consistent reporting and easy evaluation

A set of analysis tools ensures powerful search, filter and sorting functions in all lists, with operators able to predefine filter criteria, charts and lists for convenient access. Selected data can be exported to spreadsheets for reporting and further evaluation.

Central, consistent data management

The Spectrum Power™ Information Model Manager (IMM) is a proven, best-of-class engineering tool for data modeling, maintenance, and exchange. It provides data for applications within EMS for SCADA, for communication with telecontrol devices, and other company data. It serves as a central repository to efficiently manage data compliant with the Common Information Model (CIM) IEC 61970 – eliminating redundant model and data maintenance efforts.

The IMM makes all grid data available for current operation as well as all planned modifications. Innovative functions provide an exact overview of all previous changes and their documentation, along with a preview of planned future model versions based on the energization dates.
As a result, Spectrum Power™ IMM helps to meet all regulatory and security requirements.

Gain better situational awareness with the innovative Spectrum Power™ Head-up display (HUD). Benefit from modern user interaction, with highest focus on usability and functionality.

World's First Dynamic Grid Control Center
Advanced assistance system 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.

More data ...

Archiving – intuitive and intelligent

The Historical Information System (HIS) is a powerful, scalable archive system able to process very large data volumes. The use of open interfaces allows easy access for data reporting and evaluation in the office environment. The latest, intuitive Web-user interface allows seamless integration with Spectrum Power™ and enables provisioning of the data source for postmortem reviews.
Spectrum Power™ HIS offers maximum performance and security in data archiving. HIS may be situated in the control center for use by operations personnel. An additional HIS server may also be placed into a DMZ (demilitarized zone) for access from other corporate networks, while at the same time preserving the security of the control center.

Highly reliable, easily accessible and best-quality information

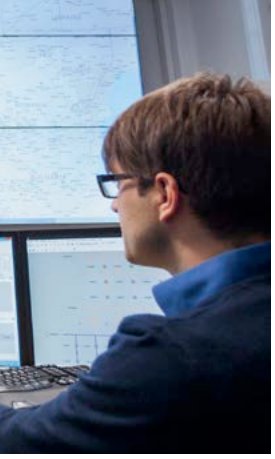
Spectrum Power™ HIS chronicles operational experience and related conditions to better determine desirable adjustments in managing assets and corresponding procedures, so higher-quality services can be implemented at a lower overall cost.

The flexible data aggregation and formula-based calculations feature can transform raw data collected with Spectrum Power™ HIS into information for general use. Ad hoc queries allow rapid access to aggregated and calculated data.

For postmortem analysis, the archived messages and values can be replayed in one-line diagrams and alarm lists. This HIS replay (flight recorder) functionality allows users to run a continuous (play/pause) or step-by-step (next/previous) history walk-through.

Historical Information System – Highlights

- Archiving of real-time values
- Data collection and storage – both periodic and on demand
- Temporary buffering for redundancy
- Manual editing and audit trail including automatic recalculations
- Flexible aggregations and calculations
- Easy to configure
- Integrated data compression
- Postmortem reviewing
- Scalable architecture
- Easily integrated with ODBC/OLE DB-based tools (e.g. Microsoft Excel)



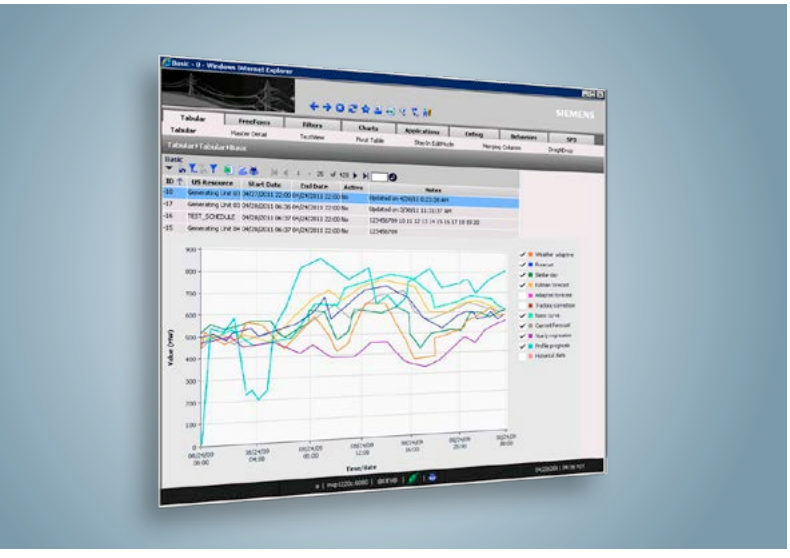
… more applications

Applications – best-in-class and future-proof

From database management to network applications, Spectrum Power™ is equipped with the latest functionality for maximum reliability and efficiency under all operating conditions. Once integrated in the data processing environment, it supports all business processes. As a leading supplier of EMS, Siemens has years of experience in providing applications that have proven highly successful in systems of every conceivable size and complexity.

Spectrum Power™ TNA

The Transmission Network Applications (TNA) suite provides tools for advanced monitoring beyond SCADA in order to assess the security of the transmission grid against planned and unplanned outages and changing system conditions. TNA will inform the operator of the current system state, the potentially harmful events to monitor and make recommendations for actions to take in response to harmful events, to proactively prevent system degradation and to lower the cost of operation.



State estimation – fast, robust and accurate

With its Orthogonal State Estimator, Spectrum Power™ represents a technical breakthrough. It meets the need for state estimation that combines the speed of a conventional design with the ruggedness of orthogonal transformation techniques.

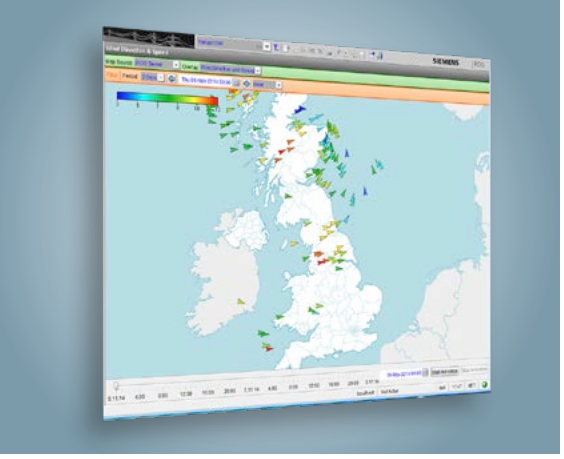
Network parameter adaptation – reliable and comprehensive

Network Parameter Adaptation (NPA) provides parameters used to generate a forecast of bus loads, regulated bus voltages, and of the status of time-switched breakers. In real-time execution, the State Estimator uses the parameters to schedule loads and desired voltages at all unobservable buses and to generate pseudo load measurements. In study situations, the Power Flow function uses these parameters to schedule bus loads and desired voltages for the specified day and hour of a study.

Security Analysis – early warnings and look-ahead

This application provides a reliable way of determining the security of a power system under specified contingencies. For each contingency, Security Analysis simulates the steady-state power flow solution and checks the network for out-of-range conditions.

Security Analysis also observes planned outages that are scheduled for the immediate future (Look-Ahead mode), and provides an early warning concerning the potential impact, giving operators time to prepare preventive measures and/or reschedule the outages.



Advanced awareness ...

Power flow optimization – practical and profitable

In the case of Spectrum Power™, the core function of optimal power flow is fully integrated in the control system, providing a clear, practical interface. It also permits largely automated operational sequences, along with detailed analytical facilities. In addition, it offers the following advantages:

- Minimized transmission losses
- Improved Volt/VAr
- Reduced reactive power transmission
- Faster correction
- Cost-effective elimination of transmission overloads
- Increased situational awareness with fully integrated look ahead grid forecast

In operation

TNA (Transmission Network Applications) supports three working environments:

1. Real-time (state estimator-based) – system conditions using real-time data provided by SCADA, AGC, etc.

2. Study (power flow-based) – used for "what if" analysis of system conditions created for a specified date/time and initialized from a real-time snapshot or from a saved case.

3. Study (state estimator-based) – analysis of offline system conditions typically related to real-time operations based on a snapshot or from a saved case that recommends actions to take in response to harmful events, to proactively prevent system degradation and to lower the cost of operation.

Transmission Network Applications – Highlights

- Field-proven applications suite supporting utilities worldwide
- Focused on robustness and ease of use
- Provides realistic and implementable measures
- Integrating the latest requirements in the field of network applications
- Support for traditional/liberalized energy markets
- Configurable as a stand-alone system or integrated with SCADA
- Enhance real-time operations and operational planning capability to ensure transmission system reliability
- Fully integrated day ahead and intraday congestion forecast
- Automatic Time Series Congestion Forecast
- Supports ENTSO-E Common Grid Model Exchange System (CGMES)

… is advanced management

System stability

Power system stability is becoming increasingly important for today's system operation; stability limits are often reached far earlier than thermal or rated limits. The Voltage Stability Analysis (VSA) application provides an online tool to identify voltage stability problems. VSA can be used in conjunction with static voltage or thermal security analysis to provide a more complete picture of system security by determining how close the system is to voltage collapse. An even more comprehensive stability analysis extending to transient stability and small signal stability is enabled by the integration of SIGUARD® DSA – an automatic and intelligent real-time dynamic security assessment tool for the calculation of the stability margin and the validation of remedial action. This contingency study runs in automatic cycles and is always based on the most recent snapshot from the State Estimator application.

Short-Term Load Forecast

The Short-Term Load Forecast (STLF) application calculates the power system load for future hours and days, thus enabling the planning of sufficient generation, spinning reserve, and standby reserve, as well as performing TNA security and optimization calculations for upcoming time instances, e.g. in the course of grid congestion management. Reliable and accurate results based on statistical and other methods are ensured by features such as the rescaling of weather forecast data and Very Short-Term Load Forecast correction. Automatic after-the-fact error analysis supports continuous tuning of the algorithm in order to adapt to changing system load characteristics.

Power Applications

The Power Applications (PA) subsystem enables the integrated control of generation resources from a grid control center for maintaining the system balance with the utmost reliability. A Load Frequency Control (LFC) application featuring a fully compensated area controller with separated small and large signal handling provides for both utmost stability and fast response. The Reserve Monitor (RM) application provides tools for the definition of active and reactive reserve requirements, periodically calculates active and reactive reserves, compares the reserves to the requirements, and signals in the case of insufficiencies. Primarily for vertically integrated utilities, Economic Dispatch (ED) and Production Cost Monitor (PCM) applications are provided and factors such as fuel efficiency costs and reserve power capacity are matched.

Published by
Siemens AG

Smart Infrastructure
Digital Grid
Humboldtstrasse 59
90459 Nuremberg, Germany

For the U.S. published by
Siemens Industry Inc

100 Technology Drive
Alpharetta, GA 30005
United States

For more information, please contact our
Customer Support Center
E–mail: spectrumpower.de@siemens.com

Article No. SIDG-B10027-00-7600
Dispo 06200 WS 08180.05
© Siemens 2021

For all products using security features of OpenSSL, the following shall apply: This product includes software developed by the OpenSSL Project for use in the OpenSSL Toolkit (www.openssl.org).
This product includes cryptographic software written by Eric Young (eay@cryptsoft.com).

Subject to changes and errors. The information given in this document only contains general descriptions and/or performance features which may not always specifically reflect those described, or which may undergo modification in the course of further development of the products. The requested performance features are binding only when they are expressly agreed upon in the concluded contract.