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Grid Operation

Digital Substations support preventing blackouts via Wide Area Monitoring Systems, Power Quality and Fault Record Analysis

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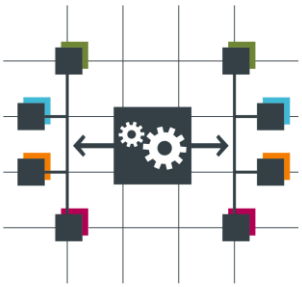
Grid operation

Grid operation ensures that an adequate amount of power is available when and where it is needed. If it isn't available, conditions in sections of the grid or even an entire power grid can become unstable, which can lead to failure and blackout of the entire grid. In steady-state operation, grid operators know the capacity utilization of the grid and which segments still have available capacity. But the increasingly dynamic nature of power grids today poses challenges: Particularly with the fluctuating infeed of wind power and photovoltaic generation as well as with unforeseen events such as equipment faults, the situation must be detected quickly to allow remedial countermeasures to be initiated immediately. Here's where digital substations really show their mettle, enabling additional valuable applications that support transmission grid operation:

- Phasor measurement combined with a wide area monitoring system
- Power quality analysis
- Fault record analysis

Benefits

- Real-time detection of instabilities e.g. power swing, islanding, overload
- Increased operational awareness – early reaction
- Improved availability
- Preventing blackouts



Reliable system operation with wide area monitoring

The load on electricity supply systems has increased continuously over the past few years. There are many reasons for this:

- Increased cross-border power trading worldwide, for example, is placing new demands on the tie lines between control areas.
- Increased input of wind power and the planned shutdown of existing power plants extend the transmission distances between generation and consumers.
- Severe weather and storms can put important lines out of operation, exposing the remaining grid to increased load.

This means that the power system is increasingly operated closer to its stability limit and new load flows arise that are unfamiliar to network control center operators.

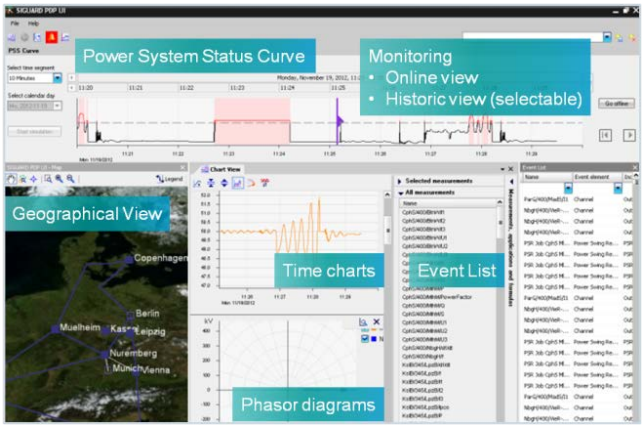
This is where Siemens' wide-area monitoring solution SIGUARD PDP (Phasor Data Processor) is of huge benefit. The solution provides condition monitoring of widely branched power transmission grids, using the data of phasor measurement units (PMU).

Available and dynamic

SIGUARD PDP helps with fast appraisal of the current situation. Power swings and transients are indicated without delay to help the control center personnel find the causes and take countermeasures.

Phasor measurement units

SIPROTEC 5 used as Phasor Measurement Units (PMU) measure current and voltage by amplitude and phase at selected stations of the transmission system. Time stamping of PMUs has to be highly precise. That is why every PMU is equipped with a GPS-driven time synchronization feature. PMUs with provide a dynamic view of the power fluctuations and other phenomena in grid operation – in real time. The PMUs are installed at sensitive points throughout the grid. The data collected is transmitted immediately via Ethernet in the protocol specially defined for transmission of synchro-phasor data in the standard IEEE C37.118.

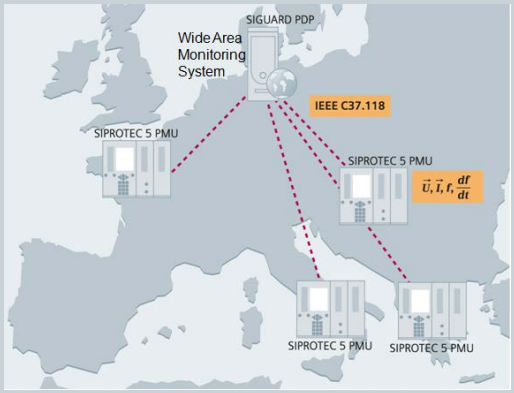


Power Quality and Fault Record Analysis

Steady-state, fault-free grid operation requires that all electrical consumers and producers have supply voltage that meets specific defined criteria. Deficient grid quality can adversely affect the behavior, cause electrical consumer equipment to fail, and endanger people and investments. Typical indications include frequency fluctuations, variations in voltage level, short-term voltage changes (drops, increases, or interruptions), longer-term voltage changes (overvoltage and undervoltage), transients (temporary overvoltage), and signal distortion.

Faults and power quality-related events in power networks are becoming more and more complex. This is especially the case when a fault occurs and a high number of protection devices trip due to evolving faults. Depending on the type of the fault and the type of the line, different ways of fault analysis can be required. As an example, the calculation of the fault location on a transmission line with an overhead line segment and cable segment and parallel line will be more complex and different than the analysis of a fault on a simple overhead line.

SICAM PQS and SIMEAS SAFIR allow that all fault records and power quality data are analyzed in one system. A diagnostic system integrated helps to analyze a fault and identify the fault location in a very short time. All data related to a power system event are stored into a single data base which considerably facilitates the analysis: transient records, slow-scan records, voltage dips, and others. The applications can then determine critical event patterns. Users browse the list of events which draws the attention on the spot and patterns of interest for each event. Events are tagged as important based on several criteria and users can register to receive notifications based on their specific preferences.



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