



SIGUARD[®] solutions

Dynamic security assessment with SIGUARD[®] DSA



At a glance

Power system stability plays an increasingly important role in system operation and planning today. Stability limits are often reached far earlier than thermal or rated limits. The growing complexity of power systems increases the risk of blackouts. Consequently, network operation can not 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.

Siemens Power Technologies International (Siemens PTI), your provider of network consulting, network planning software and training on the Siemens T&D portfolio, offers SIGUARD[®] solutions, a combination of software, training and consulting to prepare the customer for new challenges and upcoming security requirements. Applying SIGUARD[®] solutions offers the following benefits:

- Blackout prevention
- Increase of power system utilization
- Improvement of situational awareness

The challenge

Reliable electricity supply is the backbone of modern societies. The dependency of economic, industry and public sectors on uninterrupted power supply is tremendously high. At the same time the risk of blackouts is increasing due to a change in power system development, which can be observed in almost any country of the world. This change is characterized by growing load demand, distributed generation, renewable energies, liberalization, smart grid technologies and new transmission equipment. Owing to these changes, power systems operate closer to stability limits. Simultaneously, the number of active elements and possible remedial actions in case of stability problems are increasing.

As a matter of fact, this has already been recognized by most regulating agencies, and as a consequence of large blackouts an increase of situational awareness has been claimed. To correctly assess a power system's stability, the operator needs to know the stability margin and have assistance during the decision making process when it comes to finding the most sufficient solution in case of stability problems.

Our solution

SIGUARD[®] solutions support the system operator in this decision making process. The basic idea is to increase the observability and the controllability and to perform an automatic, intelligent security assessment. An overview of SIGUARD[®] software tools is given in figure 1.



Figure 1: SIGUARD[®] solutions

SIGUARD[®] PDP – Phasor Data Processor increases the observability of power systems with the help of time synchronized, very exact measurements

SIGUARD[®] DSA – automatic and intelligent Dynamic Security Assessment for calculation of the stability margin and validation of remedial actions

SIGUARD[®] PSA – automatic and intelligent Protection Security Assessment for finding weak points in the protection system

SIGUARD[®] WAC – Wide Area Control system for realization of the optimal remedial actions, which were validated in SIGUARD[®] DSA

Siemens PTI – Network Consulting

Answers for infrastructure.

SIEMENS

SIGUARD® WAP – Wide Area Protection system for realization of adaptive settings and special protection schemes, which were validated in SIGUARD® PSA
SIGUARD® DSA

Dynamic security assessment (DSA) is part of SIGUARD® solutions. It is the heart of the model-based system analysis. Its main focus is on online application to support the system operator in taking critical decisions. The extremely fast power system simulator running in the background can be executed on a computation cluster and, hence, is able to perform a comprehensive contingency study of the largest existing networks.

The contingency study cycles automatically, always taking the most current snapshot from the SCADA system as the basis. The results from this study are analyzed and presented to the user. The procedure of intelligent results analysis is based on the experience of power system dynamics experts and is customized to suit the specific needs and technologies of different power systems.

SIGUARD® DSA takes into account all possible stability phenomena, such as:

- Voltage stability
- Transient stability
- Small signal stability

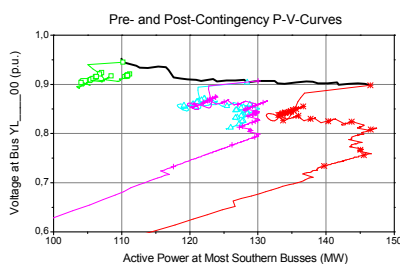


Figure 2: P-V curves from four different working points (red and magenta curve: voltage collapse)

By considering short term forecasts of loads, generation and switching actions, SIGUARD® DSA can even prepare for future situations, leaving more time to

the operator to prove the situation and the proposed remedial actions.

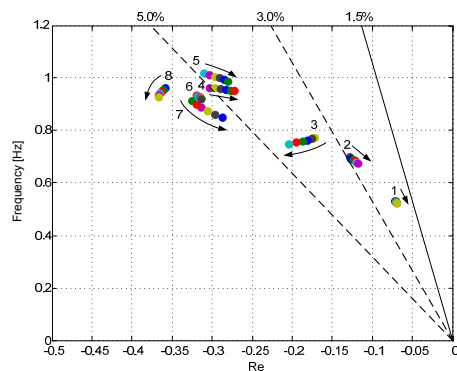


Figure 3: Presentation of system oscillation modes on complex plane with regard to variations in load or network topology alternations

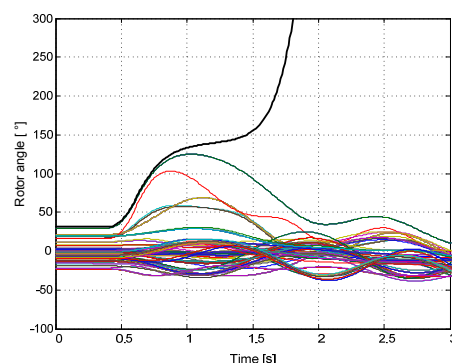


Figure 4: Transient stability after severe fault, a generator becomes unstable and is separated from the synchronous group

Consideration of protection devices

In more than 50% of the past blackouts, the protection system was involved. Protective devices can lead to cascading outages of multiple network elements. Such events can only be observed in dynamic security assessment if the protection devices are modeled for simulation in time domain.

Visualization

A multi-level results visualization with traffic-light representations of the stability levels is prepared in the background in order not to distract the control room personnel from the daily work. In case of

critical situations the user can dive into a more informative results presentation. This representation shows the effects of system disturbances as well as the origin of the stability problems which then allow the operator to define possible solutions to a contingency.

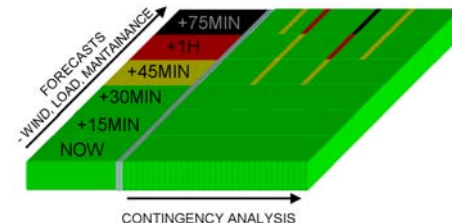


Figure 5: Example of a results presentation

Services provided by Siemens

Siemens PT offers a combination of software, training and consulting to our customers. The software forms the basis of SIGUARD®. We offer the following services:

- On-site commissioning of individual or all SIGUARD® solution parts
- Adaptation to the control room applications of any vendor
- Adaptation of the power system models of any vendor to the SIGUARD® format
- Adaptation to the power system specific requirements (e.g. grid code)

Our trainings offer for SIGUARD® solutions comprises courses on:

- Power system dynamics
- Voltage stability assessment
- Transient stability assessment
- Small signal stability assessment
- Handling of the SIGUARD® software components

In addition, as consultants we provide ongoing support when it comes to system studies regarding special protection schemes, remedial actions, power system and protection planning.