DSATools™
Dynamic Security Assessment Software

DSA Manager™

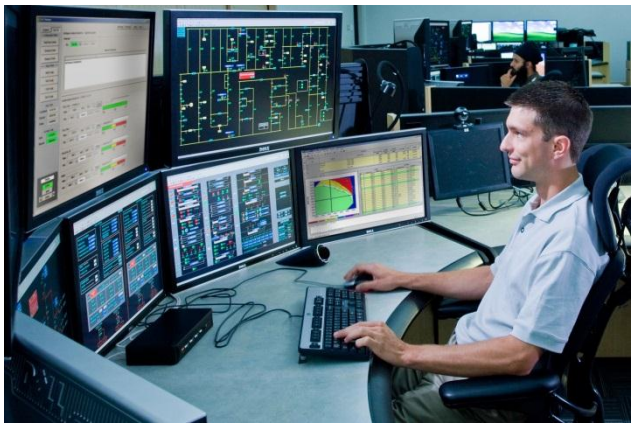
Secure operation of power systems is of ultimate importance to the reliable supply of electricity and this is also the center element in the modern ***smart grids***. The conventional off-line dynamic security assessment (DSA) of power systems often cannot meet the requirements of system operations in the new environment. The on-line DSA, which uses real-time system conditions obtained through SCADA/WAMS and state estimation in an Energy Management System (EMS), provides a viable solution to this problem.

DSA Manager™ offers a platform on which the security assessment software in Powertech's DSA*Tools*™ suite is applied in an on-line DSA system, providing system security monitoring, prediction, alarming, control, and other advanced functions required in the operation of smart grids.

Application Scope

An on-line DSA system based on solutions provided by DSA Manager™ can be used for the following applications:

- System security status and margin monitoring.
- Stability limit determination.
- Identification of preventive/corrective control actions.
- Impact assessment of renewables on system security.
- Verification of System Protection Schemes (SPS).
- Transaction settlement in power market.
- Determination of active and reactive power reserve.
- Scheduling of equipment maintenance.
- Support to PMU/WAMS applications.
- Calibration and validation of power system models.
- Preparation of models for system studies.
- Post-mortem analysis of incidents.
- System restoration.



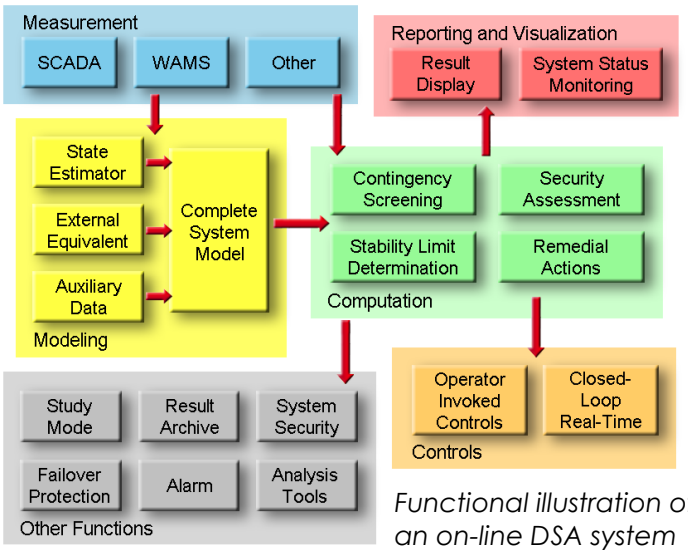
Product Features

- **Common platform to integrate DSATools™ with Energy Management System (EMS)**
- **Static and dynamic security assessment including stability limit calculations**
- **Flexibilities in handling real-time and fixed data**
- **Comprehensive analysis scenario definition capabilities**
- **Security violations, stability limits, and alarms reported in simple colour-coded display**
- **Visualization of system security trends vs time**
- **Study mode for analysis of history and future cases**
- **Software/hardware failover and bad data detection/correction functions**
- **Parallel, distributed computations for scalable performance**

System Overview

DSA Manager™ acts as an interface module in an on-line DSA system with five main functions covering the management of,

- **security assessment modules:** computation clients and engines of each security assessment module (VSAT, TSAT, SSAT) are integrated and configured to perform the required analysis tasks.
- **computation hardware:** all computation servers, workstations, and data server deployed are set up and scheduled to function properly.
- **models, data, and analysis scenarios:** all models and data required are specified and maintained. In addition, analysis scenarios are defined for the target applications.



Functional illustration of an on-line DSA system

- **result archiving and visualization:** computation results are saved and analysis cases archived for future use. Various result visualization tools are available and direct access to more advanced output analysis via DSA*Tools*™ DSAOA module is provided.
- **system operation:** this includes a set of functions for system configuration, operation monitoring, system security, failover, and maintenance of the on-line DSA system.

Security Assessment Options

DSA Manager™ can be configured to interface with any or all of the security assessment programs in Powertech's DSA*Tools*™ suite:

- Voltage Security Assessment Tool (**VSAT**).
- Transient Security Assessment Tool (**TSAT**).
- Small Signal Analysis Tool (**SSAT**).

All supported security assessment options in these programs can be enabled for on-line DSA, including,

- Base case security analysis with various security criteria.
- Transfer analysis to determine stability limits.
- Remedial action analysis to recommend preventative and/or corrective control measures when required.

Such analyses are done for the specified contingencies, power transfers, and other models supported by DSA*Tools*™ and defined in DSA Manager™.

In the **real-time mode**, analysis scenarios are set up in DSA Manager™ and an analysis cycle is triggered automatically when a real-time system snapshot (with other optional information) is passed from EMS.

In addition, all security assessment programs are also available through the **study mode** in DSA Manager™ for the what-if analysis of archived history cases or forecast future cases.

System Architecture

DSA Manager™ supports an on-line DSA system with an architecture comprised of the following components:

- A **DSA Client** on which all data and analysis tasks are managed. For improved reliability, dual Clients can be used and DSA Manager™ handles the Client failover.
- Multiple **Computation Servers** on which all calculations are done. Analysis scenarios are assigned to available servers by the built-in distributed computation feature.
- A **Data Server** on which input data, computation results, and analysis cases are stored.
- **User Workstations** on which current and history DSA results are displayed using the DSA Monitor software included in the DSA Manager™ package.

It is possible to set up multiple DSA systems in one network for production, backup, forecast, market, studies, development, QA, testing, etc. These systems can be coordinated with the following available functions:

- Data sharing.
- Custom configuration of analysis tasks.
- Custom configuration of computation servers.
- System synchronization.

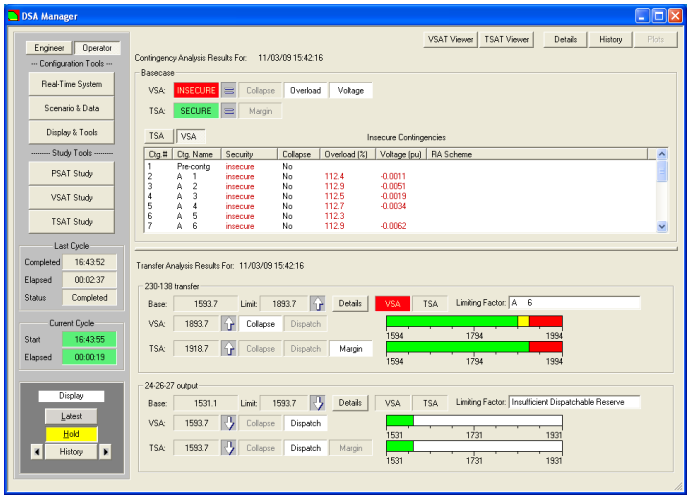
Model and Data Requirements

DSA Manager™ can be integrated with virtually any EMS system to exchange real-time and fixed data available in the following formats,

- DSA*Tools*™ native format.
- Common third party formats.

In addition, user can also define and maintain fixed data in DSA Manager™. All data can be prepared with the **equipment name** concept which ensures unique matching of real-time and fixed data for an analysis case.

For compatibility with off-line analysis, all models and data supported in the standard version of DSA*Tools*™ are available for on-line DSA.



The following additional features are available in DSA Manager™ to handle models and data:

- Certain data can be defined in both EMS and DSA Manager™; user can specify the rules to merge data for the actual analysis.
- Certain data can be prepared in mixed formats. For example, the base network model can be prepared in a standard bus/branch format for simplicity, while the full node/breaker details can be added to the region subject to analysis.
- Multiple data sets can be defined independently and matched with different analysis scenarios.
- Identical data editing interfaces to the standard DSA*Tools*™ programs.

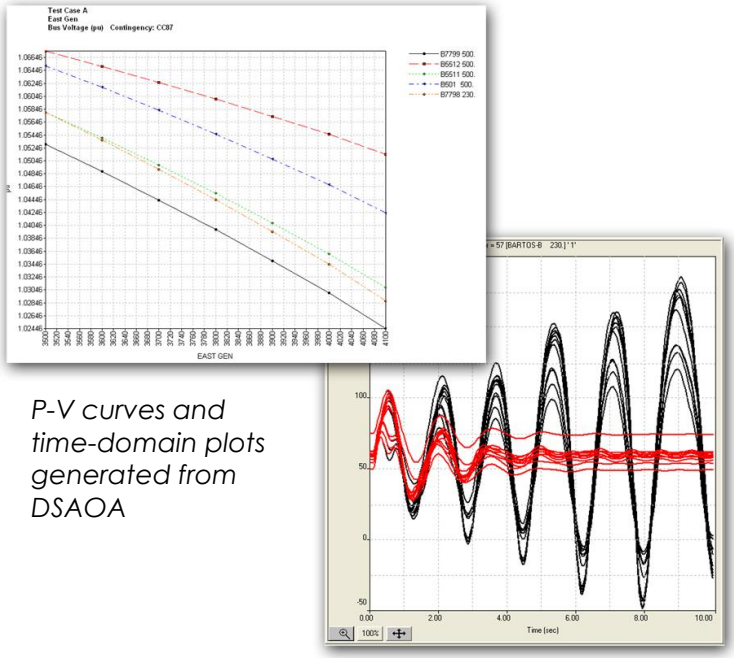
Result Archiving and Visualization

Each real-time case analyzed is archived in data server. Such cases can be loaded back in DSA Manager™ for examining full results and can also be loaded in DSA*Tools*™ programs easily with functions provided on DSA Manager™ interface. Selected results can also be deposited in third party databases such as PI.

Various types of results are displayed in DSA Manager™:

- Basecase security status and unstable contingencies.
- Security violation details with suggested remedial actions if applicable.
- One or two dimensional stability limits with limiting security violations and causes.
- Interface flow, generator group output, and minimum voltage monitoring.
- Histogram showing time-tagged history security results.
- Security violation alarm.
- Custom P-V, time-domain, and other plots from DSAOA.
- Wherever possible, results displayed are consolidated from all installed security assessment modules.

Results in XML format are exported and can be used in third party visualization tools.



P-V curves and time-domain plots generated from DSAOA

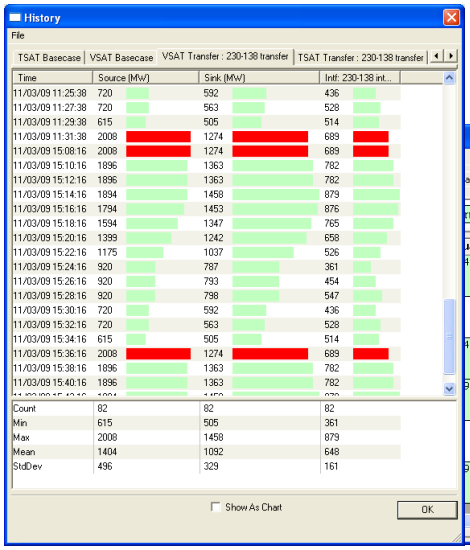
Study Mode

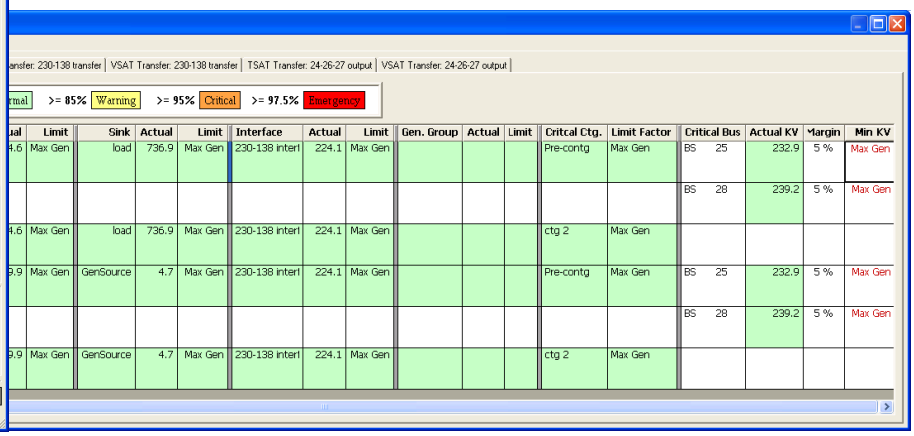
DSA Manager™ supports two study modes:

- **Study mode for history cases**: all real-time cases analyzed and archived can be loaded into off-line version of DSA*Tools*™ programs with the interface provided in DSA Manager™. User is free to make modifications on models, data, and analysis scenarios in the studies. All features, including GUI, of the off-line version of the programs are supported.
- **Study mode for future system conditions**: this is supported with a special version of DSA Manager™ (referred to as ST DSA Manager™). Under this mode, future study cases (next hour, next day, etc.) can be submitted and processed in batch.

In addition to the features available in DSA Manager™, ST DSA Manager™ supports:

- Custom user profile (including data and analysis scenario setup), so each user can maintain unique analysis scenarios.
- Case queuing so that multiple study cases can be submitted simultaneously for parallel processing.

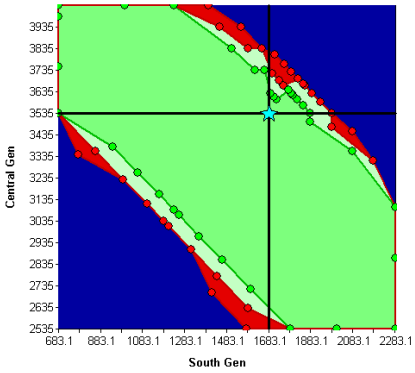




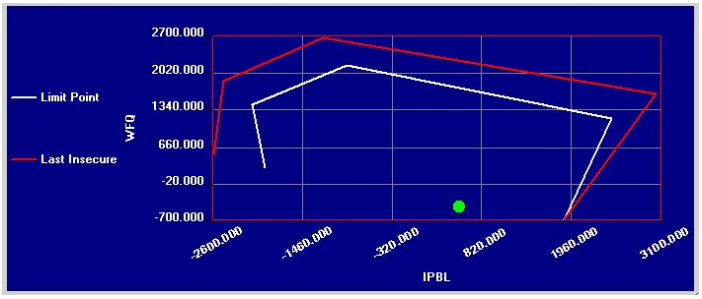
Other Features

DSA Manager™ includes other features:

- Detection and correction of deficient real-time data and system condition during analysis.
- Handling of high priority real-time cases.
- Real-time powerflow case re-conditioning.
- Lookup table for fault clearance time.
- Rule-based conversion of VSAT contingencies to TSAT format.
- Contingency grouping for specific transfers.
- Ability to process forecast cases, in addition to real-time cases, in real-time mode.
- Comprehensive configuration options available to set up an on-line DSA system.
- Data auditing.
- DSA client, server, and analysis cycle monitoring.
- Daily message logs.
- Runs on Microsoft Windows Server 2008/2012 R2.



Two methods of showing limits for a two-dimensional transfer: source and sink with indication of various types of violations (left) and specified interfaces (below)



Other Powertech Services

- Evaluation of transfer capability and security limits
  - Powerflow analysis
  - Transient Stability analysis
  - Small-Signal Stability analysis
  - Voltage Stability analysis
- Post-mortem analysis of system disturbances
- Frequency control assessment
  - Islanding studies
  - AGC & governor performance
  - Design and evaluation of under-frequency load-shedding schemes
- Increasing transfer capability
  - Control-tuning and design
  - Load shedding schemes
  - Reactive compensation planning
  - Special protection system design and verification
- Assessment of planning alternatives
- Integration analysis of conventional and renewable generation
- Custom modelling & dynamic model reduction
- Generator field testing, model development & validation
- Load characteristic measurement and model development
- Custom software and model development
- Training

In addition to extensive power system analysis software and study capabilities, Powertech has a $50 million lab and test facility which includes high voltage, high current, and high power labs, as well as capabilities in hydrogen technologies, chemistry, metallurgy, and materials engineering.

For more information contact

Powertech Labs Inc.
12388-88th Ave
Surrey, British Columbia
CANADA V3W 7R7

Phone (604) 590-7500
Fax (604) 590-6656
Email DSAinfo@powertechlabs.com
Web www.dsatools.com

Powertech

www.powertechlabs.com

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