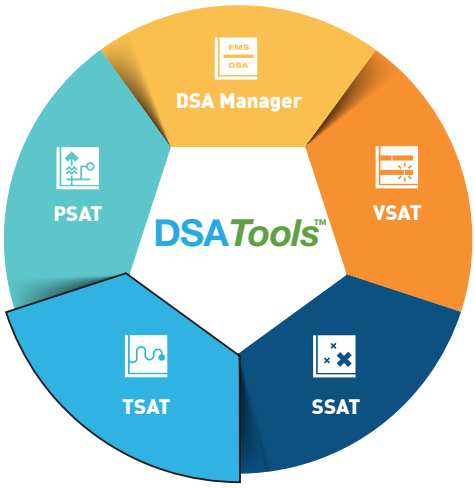
TSAT Transient Security Assessment Tool

TSAT is a software tool for transient security assessment of power systems. This tool is designed to meet the growing challenges facing the power industry resulting from the increased demand on the secure and relaible operation of power systems.



TSAT's extensive computational capabilities offer a "one-stop" solution to the transient security analysis problem.

Complemented by other tools in the DSA*Tools*™ suite, namely PSAT (Powerflow & Short circuit Analysis Tool), VSAT (Voltage Security Assessment Tool), and SSAT (Small Signal Analysis Tool), TSAT helps accurately and completely assess transient security problems of power systems.

TSAT's core technology is a nonlinear time-domain simulation engine that is able to give accurate responses of large interconnected power systems following various types of disturbances. Built on this simulation engine is a set of security assessment modules that perform comprehensive evaluation for the system dynamic performance measured by NERC or comparable system planning and operation standards.

TSAT can be configured in either off-line or on-line mode, both of which share the same computation engine. With fast computation speed, advanced modeling capabilities, a rich set of analysis functions, and an easy-to-use interface, TSAT will surely be able to meet the requirements for the most demanding system studies.

APPLICATION SCOPE

TSAT provides analysis functions and modeling capabilities for the following applications:

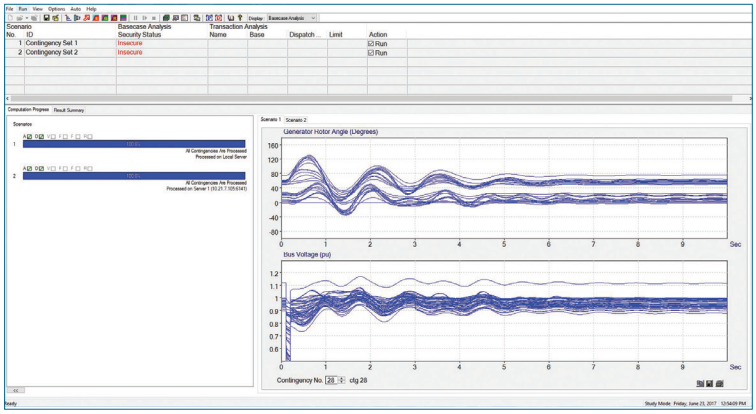
- Transient stability analysis for large power grids with compliancy to NERC standards
- Transfer limit determination
- On-line transient security assessment
- IPP integration studies
- Analysis of renewable energy sources
- Cascading outage analysis
- Control design and tuning (with SSAT)
- Small signal stability studies (with SSAT)
- Voltage stability studies (with VSAT)
- Frequency stability analysis
- Design of special protection systems (SPS)
- Verification of device model and performance
- System restoration and black-start analysis
- Construction of system responses in post-mortem incident analysis
- Generation of simulated PMU signals (with ePMU)
- Other

PRODUCT FEATURES:

- *Powerful off-line analysis capabilities*
- *Readily configured with EMS for on-line use*
- *Selection of various security compliant with NERC standards*
- *Comprehensive modeling support*
- *Extensive contingency analysis features*
- *Stability-constrained transfer limit determination*
- *Case setup, model/data verification, and output analysis tools*
- *Scalable distributed computation engine*
- *Available add-on modules with extended application capabilities*
- *Possibility for hybrid simulations with an electromagnetic transient simulation engine*

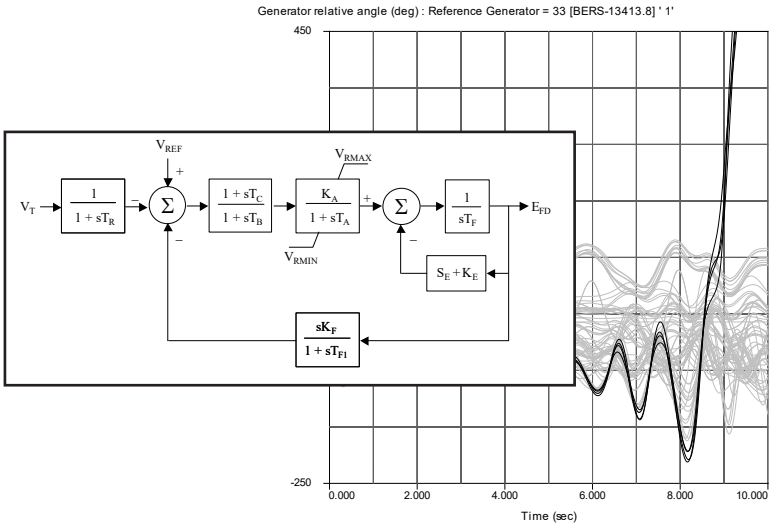
Powertech

TSAT Transient Security Assessment Tool



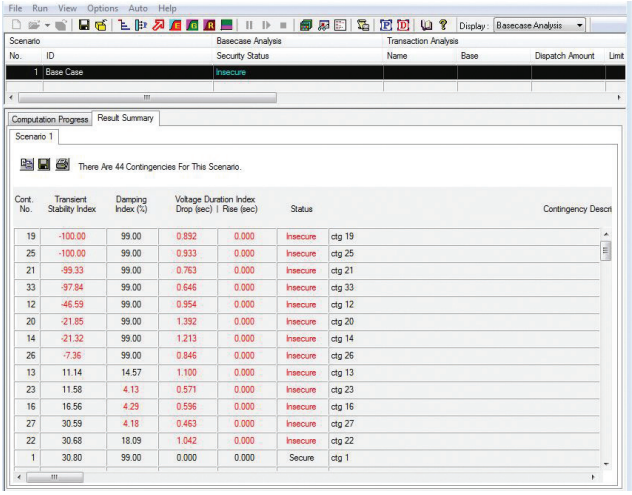
SECURITY ASSESSMENT

- **Transient stability:** a transient stability index is provided with a choice of computation algorithms.
- **Damping:** the minimum damping of the dominant rotor angle oscillation in the system is computed.
- **Transient voltage:** violations are captured with custom under-voltage and over-voltage criteria.
- **Transient Frequency:** violations can be identified for a specified lower/upper range and rate of change limit.
- **Relay margin:** margins to relay operation on all monitored lines are computed.
- Application of security criteria is customizable for different regions of the system and contingencies.
- Alternative numerical integration methods are available.
- All contingencies can be ranked using any of the indices for scanning of large number of contingencies.



DETAILED CONTINGENCY ANALYSIS

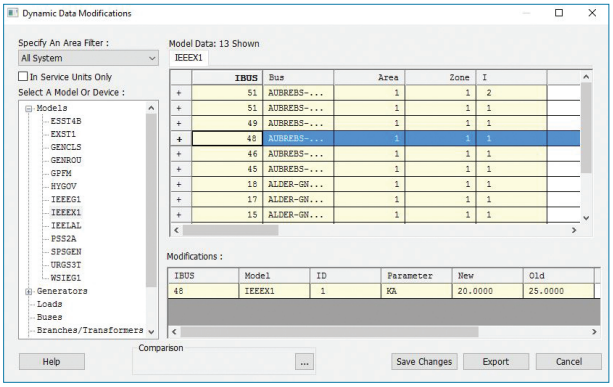
- Fully customized contingencies can be easily created with the user interface provided.
- For compliancy studies (such as NERC TPL), contingencies can be created by pre-set rules or by the add-on module Contingency Creator.
- Simulations can be early terminated to achieve fast computation speed.
- A wide selection of events can be simulated:
  - Faults of various types (three phase, single phase, two-phase-to-ground) at bus or on a branch
  - Branch (single, two, or three phase) tripping and reconnection, shunt switching, adding or modifying branch
  - Generator tripping, exciter or governor reference setpoint changes
  - Load shedding, load ramping, motor starting
  - Breaker-based switching operations
  - Pre-simulation outages and powerflow dispatches
  - Dependent contingencies

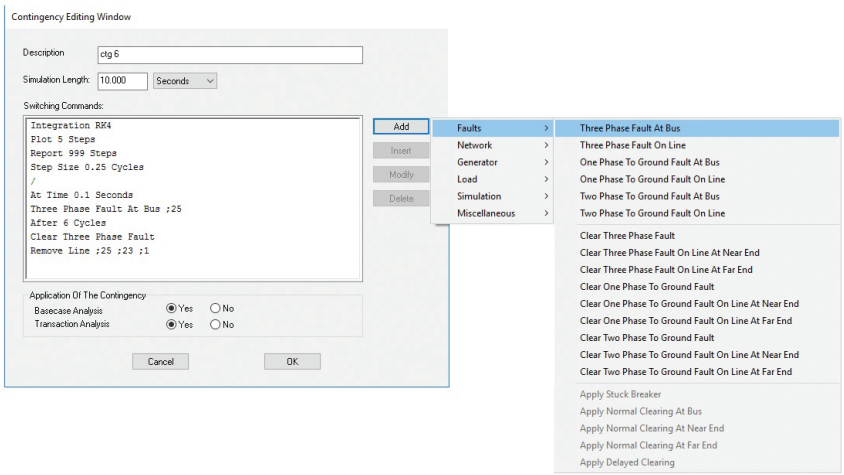


DETERMINATION OF STABILITY LIMITS

TSAT can help determine stability limits in a system:

- Very flexible power transfer definition (one- or two-dimension), based on the source-sink concept.
- Different stability limit search strategies, including manual, binary, and fully automatic.
- Forward and backward limit searches.
- Built-in powerflow dispatcher and solver.





- Determination of the maximum transfer capability on an interface, based on any or a combination of all available security criteria.
- Limit determination philosophy consistent with the similar functions in VSAT and SSAT; thus results are comparable.

MODEL LIBRARY

TSAT supports a comprehensive model library, including the following conventional models:

- **Generator:** from classical to two-axis 6th order models.
- **Excitation system:** all IEEE standard exciter/AVR and PSS models and common extended models.
- **Speed governing system:** all IEEE standard models and common extended models.
- **Relay:** under-voltage/frequency load shedding, switchable shunts, distance relay.
- **Load:** ZIP model, voltage/frequency dependent model, induction motor, and composite load model.

Among the advanced modeling capabilities, TSAT supports:

- **User-defined modeling:** function block and connectivity-based UDM approach with capability to interface with user-written control blocks.
- **Renewable energy source models:** wind turbines, photovoltaic plants, storage devices, etc.
- **FACTS model library:** SVC/SVS, TCBR, STATCOM, TCSC, SSSC, TCMCT, TCPST.
- **HVDC model library:** two- and multi-terminal HVDC models (LCC and VSC), DC grid modeling, converter-based FACTS models.
- **Extended term simulation model library:** OEL, ULTC. Special Protection System (SPS) models.

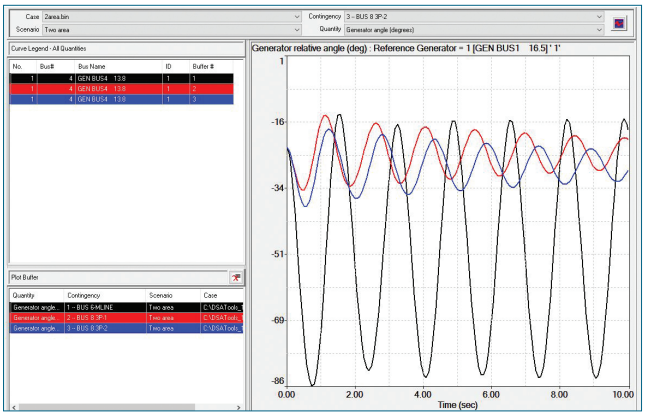
TSAT supports network and data in the node/breaker format.

ANALYSIS RESULTS MONITORING

A wide selection of system quantities can be monitored during simulations, including:

- **Generator:** angle, speed, voltage, mechanical and electrical power, field voltage, etc.
- **Bus:** voltage, angle, frequency.
- **Branch:** power, current, apparent impedance.
- **Load:** power, voltage.
- **Other:** generator state variables, motor/FACTS/HVDC quantities, UDM block outputs, branch interface quantities, regional quantities, etc.

Quantities to be monitored can be customized, and system monitoring can be specified using a number of options.



TSAT Transient Security Assessment Tool

CASE SETUP AND OUTPUT ANALYSIS

- Connection to PSAT for examining, modifying, and solving powerflow.
- Connection to UDM Editor for creating, examining, and modifying user-defined models.
- Different levels of details for examining base case and transfer analysis results.
- Comprehensive output analysis module (DSAOA) that creates various types of plots and output reports.
- DSAOA plotting module for extensive studies of simulations, with flexible plotting options:
  - Highly customizable x-t and x-y plots.
  - Batch plotting capability based on scripting language.
  - Data and graphics importing/exporting facilities (ASCII text, MS Office, and Postscript).
  - Study tools such as relay analysis, case comparison, curve statistics, and detailed Prony analysis.

OTHER FEATURES

- Capability to integrate, through the DSA Manager™ module, with EMS for on-line dynamic security assessment.
- Generation of simulated PMU signals in IEEE C37.118 format from near real-time simulations with the add-on module ePMU.
- Creation of the complete contingency set automatically according to NERC TPL standard with the add-on module Contingency Creator.
- Possibility of performing hybrid simulations with an electromagnetic transient simulation engine (such as RTDS).
- Power system components can be identified using bus numbers, bus names, or equipment names.
- Model and data verification tools:
  - Exciter/governor/renewable generator step response simulations.
  - No disturbance test simulation.
  - Injection of bus V magnitude/frequency curves ("playback simulations").
- Case archive feature to store or share study cases.
- Snapshot feature to pack a simulation for later continuation of the simulation.
- Data conversion tool to import powerflow and contingency data in third-party formats including PSS/E, PSLF, BPA, etc.
- Distributed computation to enable simultaneous simulations of multi-contingency/scenario cases on multiple servers, or multiple CPU cores.
- Analysis of power systems of up to 100,000 buses and 15,000 generators.
- Runs on MS Windows 7/10/server 2012 R2/server 2016

OTHER POWERTECH SERVICES

- Licensing of the power system analysis software package DSA*Tools*™
- Licensing of other software products for utility applications
- Implementation of on-line dynamic security assessment (DSA) systems
- Development of custom software systems
- Development of models for use in power system analysis
- Generator field testing, model development and validation
- Training
- Technical consultancy studies including
  - Development of power system base cases
  - System planning and operation studies
  - Facility (including renewables) interconnection studies
  - Compliancy studies (such as NERC TPL, CIP, UFLS, etc.)
  - Post-mortem analysis of system disturbances

ABOUT POWERTECH LABS

Powertech Labs Inc. is one of the largest testing and research laboratories in North America, situated in beautiful British Columbia, Canada. Our 11-acre facility offers 15 different testing labs for a one-stop-shop approach to managing utility generation, transmission and distribution power systems.

Outside of the utilities industry, Powertech provides routine testing capabilities, product development, research and consulting services to support an array of industrial-type operations, electrical equipment manufacturers and automotive original equipment manufacturers.

www.powertechlabs.com

FOR MORE INFORMATION CONTACT:

Lei Wang - 604.590.7450
Director, Software Technology
lei.wang@powertechlabs.com

dsainfo@powertechlabs.com
www.dsatools.com

81022-0043

Powertech