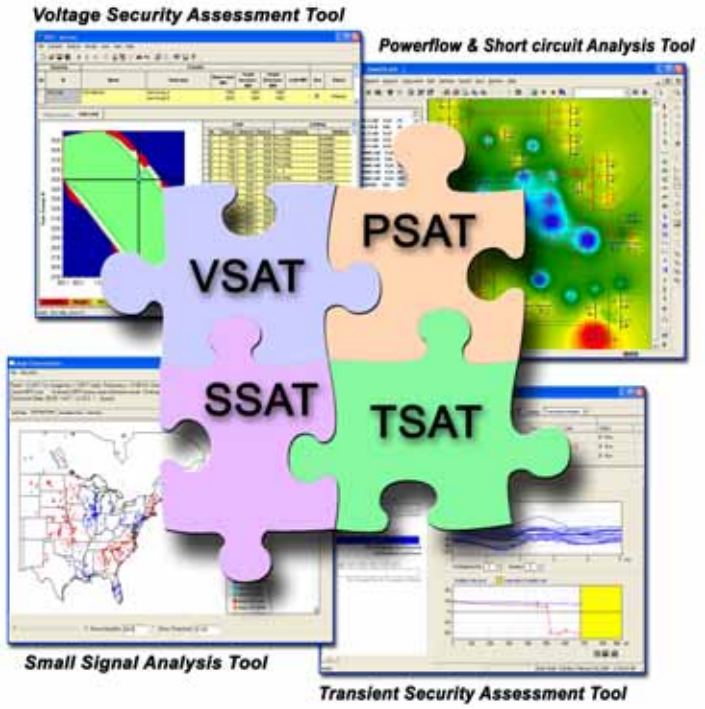
DSATools™
Dynamic Security Assessment Software

TSAT Transient Security Assessment Tool

TSAT is a software tool developed by Powertech Labs Inc., for transient security assessment of power systems. This tool is designed to meet the growing challenges facing the power industry as witnessed with the widespread smart grid development and applications. Its extensive computational capabilities offer a "one-stop" solution to the transient security analysis problem. Complemented by other tools in Powertech's **DSA*Tools***™ suite, namely PSAT (Powerflow & Short circuit Analysis Tool), VSAT (Voltage Security Assessment Tool), and SSAT (Small Signal Analysis Tool), TSAT helps give accurate and complete assessment of transient security problem of a power system.

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's TPL 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 your system studies.



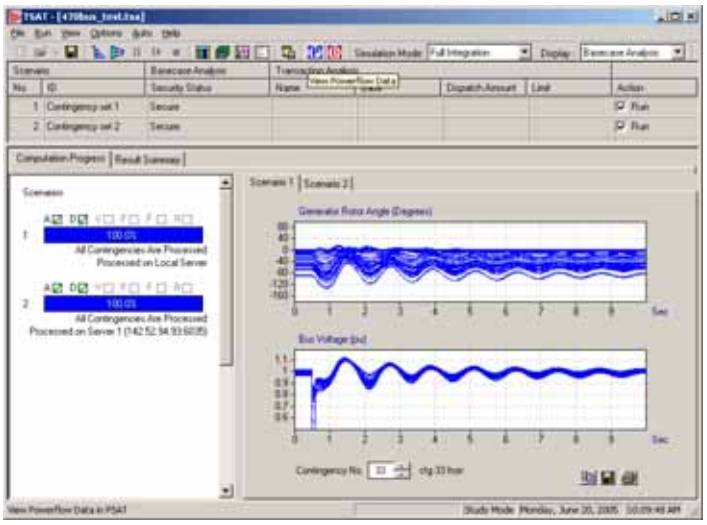
Product Features

- Powerful off-line analysis capabilities
- Readily configured with EMS for on-line use
- Selection of various security criteria,
  - transient stability
  - damping
  - tranient voltage
  - transient frequency
  - relay margins
- Comprehensive modeling support
- Extensive contingency analysis features
- Stability-constrained transfer limit search
- Case setup, model/data verification, and output analysis tools
- Scalable distributed computation engine

Application Scope

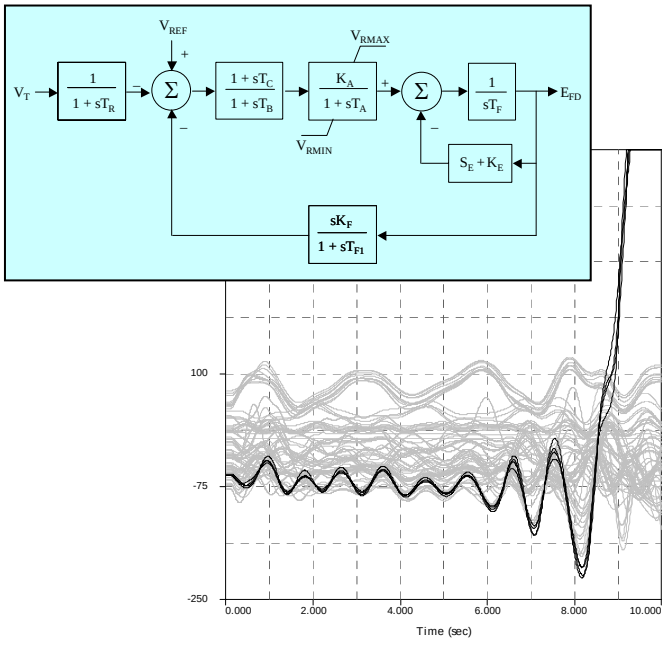
TSAT provides analysis functions and modeling capabilities for the following applications:

- Transient stability analysis in planning and operation studies
- Transfer limit determination
- On-line transient security assessment
- Independent Power Producer (IPP) integration studies
- Analysis of renewable energy sources
- 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 analysis of system incidents
- Other



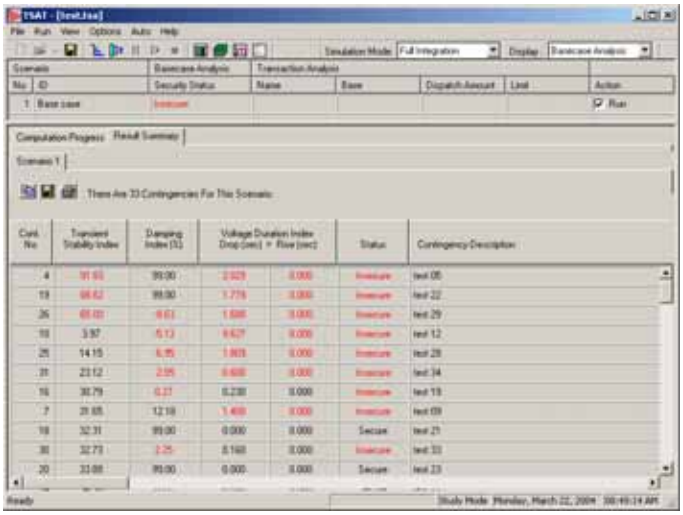
Security Assessment

- *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 by a multi-channel Prony algorithm.
- *Transient voltage:* transient voltage violations during simulations are captured with custom under-voltage and over-voltage criteria.
- *Transient Frequency:* 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.
- Security assessment is based on full time-domain simulations with detailed models, thereby ensuring the accuracy of the results.
- All contingencies can be ranked using any of the indices for scanning of large number of contingencies.



Detailed Contingency Analysis

- Contingencies can be created with custom switching events or by rules.
- Post-contingency system security status is measured by quantitative indices.
- Alternative numerical integration methods.
- Early termination of simulations to achieve fast computation speed.
- A wide selection of events that can be simulated, including:
  - Faults of various types (three phase, single phase, two-phase-to-ground) at bus or anywhere 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.
  - Pre-simulation outages and powerflow dispatches.
  - Dependent contingencies.
  - Much more . . .



Determination of Stability Limit

TSAT can help determine stability limits for power transfers:

- Very flexible power transfer definition, 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.

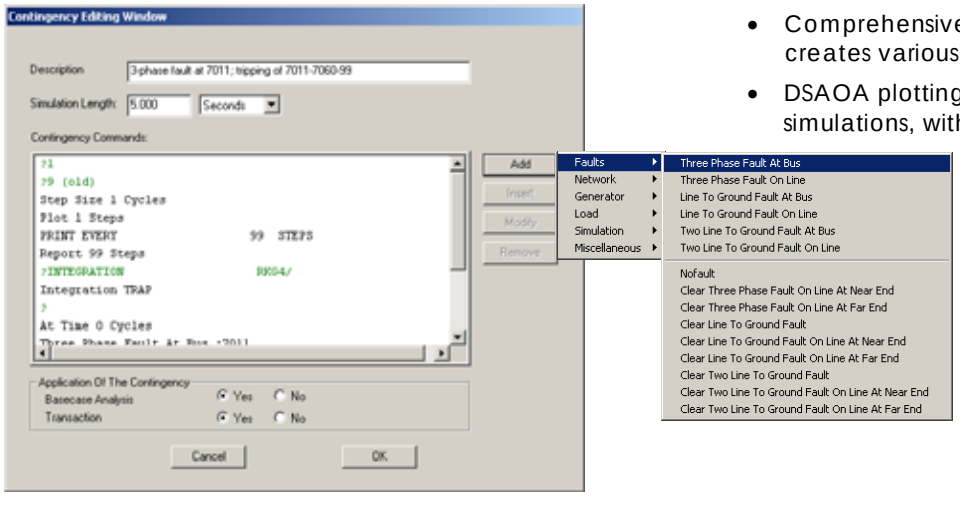
Model Library

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 offers:

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

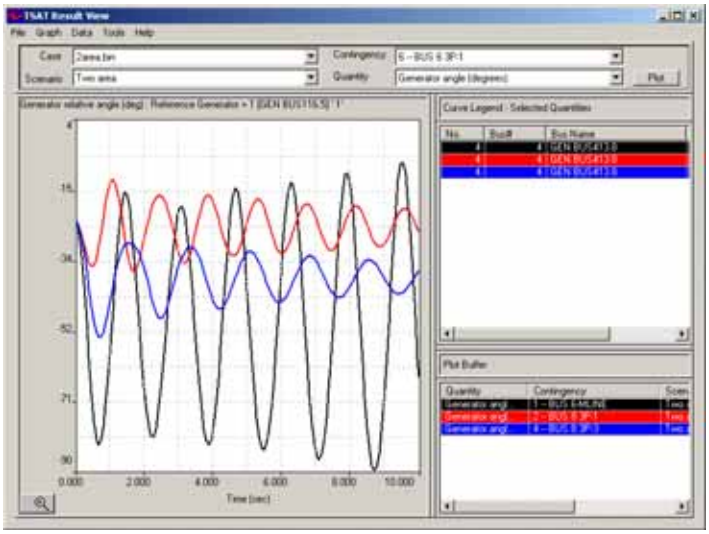


Analysis Results Monitoring

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.

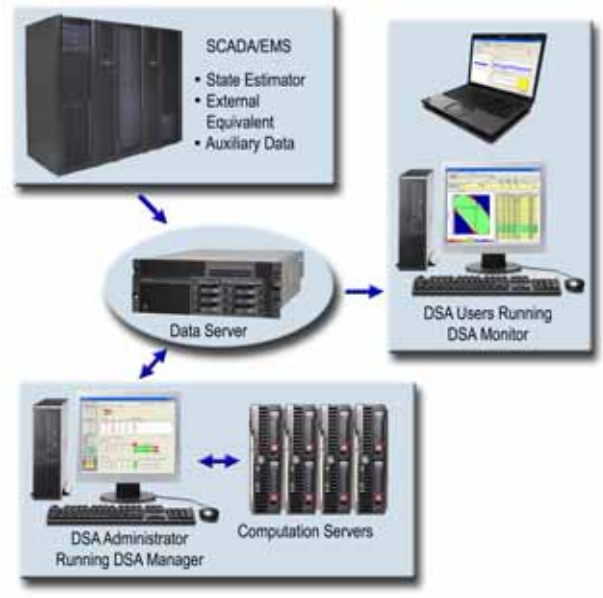


Case Setup and Output Analysis

- Connection to PSAT for examining, modifying, and solving powerflow.
- Connection to UDMEditor™ for creating, examining, and modifying user-defined models.
- Different levels of details for examining basecase and transaction analysis results.
- Comprehensive output analysis module (DSAOA) that creates various types of 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

- Power system components can be identified using bus numbers, bus names, or equipment names.
- Model and data verification tools:
  - Exciter/governor step response simulations
  - No disturbance test simulation
- Case archive feature to store or to 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-scenario cases on multiple servers, with scalable performance in terms of servers available.
- On-line TSA application with DSA Manager™ for connection with EMS system.
- Analysis of power systems of up to 100,000 buses and 15,000 generators.
- Runs on MS Windows 2000/XP/Vista/7 platform.



On-line dynamic security assessment using DSATools™

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
- Custom modelling & dynamic model reduction
- Reliability Assessment of power systems
- Generator field testing, model development & validation
- Load characteristic measurement and model development
- Custom software and model development
- Training

In addition to extensive power system 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.

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