



Star - Protection & Device Coordination

Protective Device Coordination / Selectivity
Sequence-of-Operation
Relay Testing & Simulation
Relay Test Set Interface & Equipment

**ARTTS - Relay Testing
& Simulation**



Power System Enterprise Solution

ETAP is the most comprehensive analysis platform for the design, simulation, operation, control, optimization, and automation of generation, transmission, distribution, and industrial power systems.

Customize ETAP to fit your needs, from small to large power systems

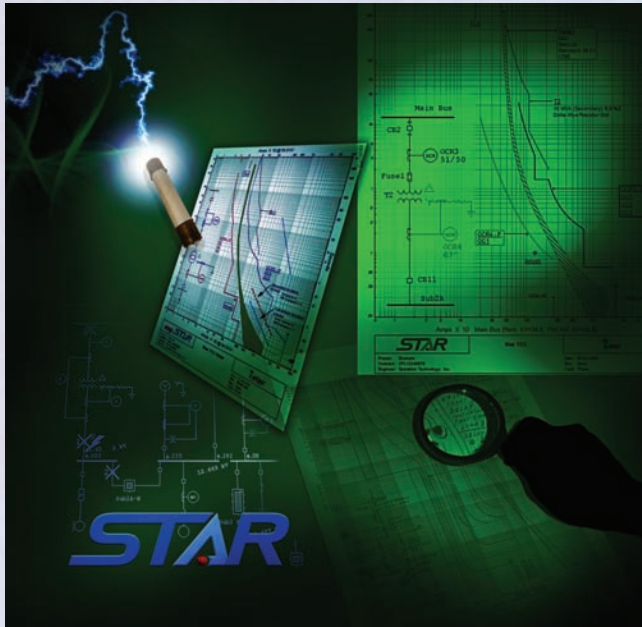
ETAP Enterprise Suite provides one solution to your power system design, analysis, and operation needs. ETAP offers a comprehensive suite of analysis modules that can be configured to suit your specific needs. This modular approach allows you to purchase only the modules you need.

◆ **Featured in this brochure**



Star - Protection and Device Coordination

Intuitive, Intelligent, Integrated



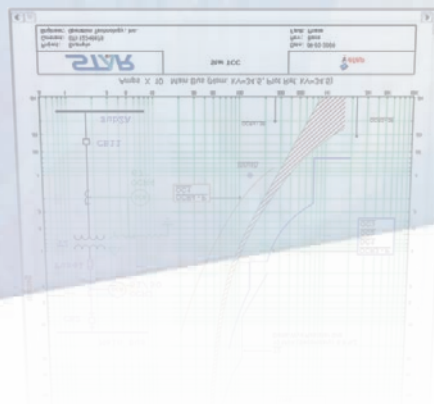
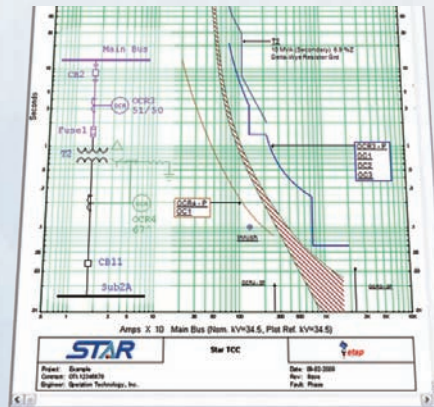
The Most Comprehensive Protection & Device Coordination Analysis Solution

ETAP Star protection and device coordination program provides an intuitive and logical approach to Time Current Characteristic (TCC) analysis. Enhanced features and capabilities, such as graphical user interface, true-to-the-form protective devices modeling, extensive Verified & Validated (V&V) device library, and integrated rule-based design, creates a desired working environment for protection and power system engineers.

Embedded analysis modules, such as Sequence of Protective Device Operation, helps the efficiency and accuracy of coordination study of protection devices.

Using intelligent one-line diagrams, comprehensive device libraries, and a three-dimensional database, ETAP Star offers insight into troubleshooting false trips, relay mis-operation, and mis-coordination.

- Device Coordination & Selectivity
- Sequence-of-Operation
- Protection Zone Selection & Viewer
- Verified & Validated Library
- Relay Test Set Interface



Coordination

Protective Device Coordination & Selectivity



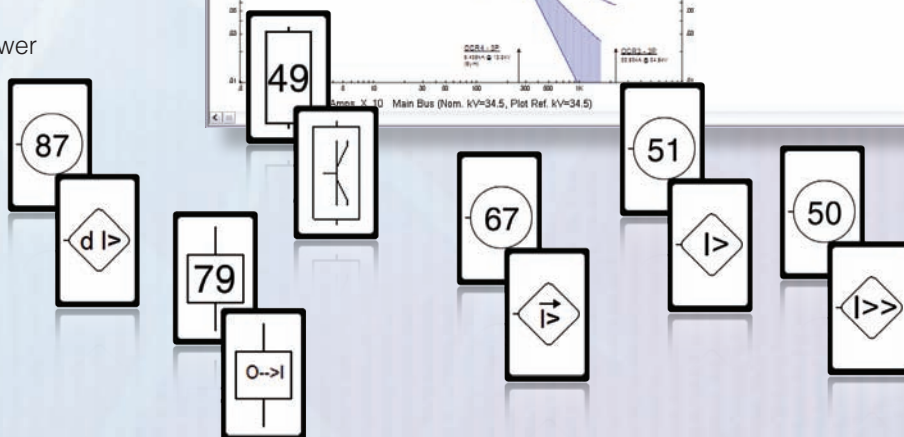
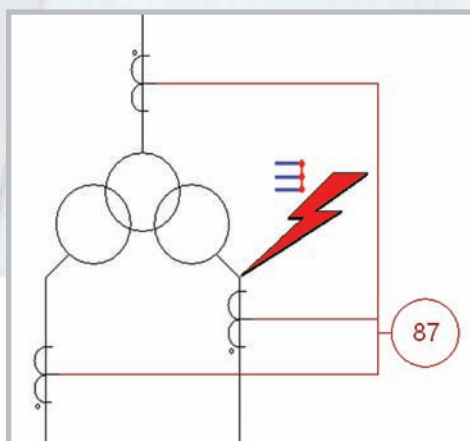
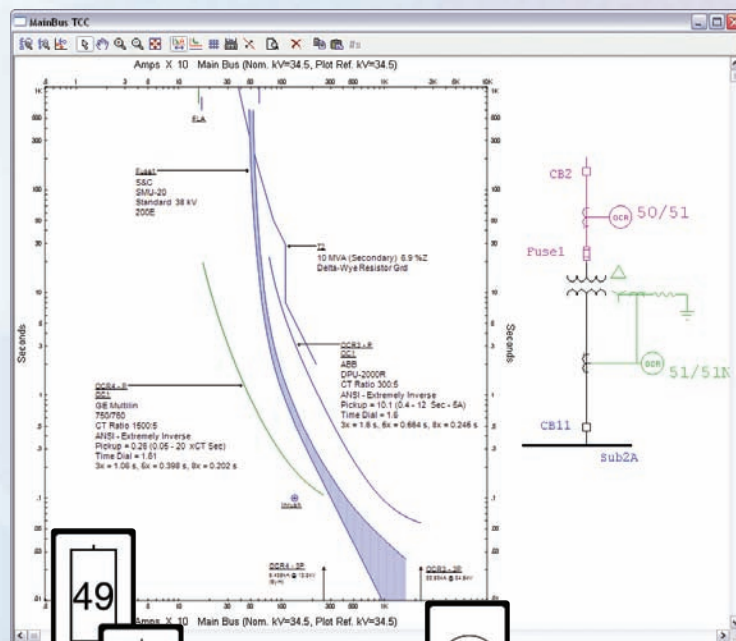
StarView Toolbar

Capabilities

- AC & DC coordination
- ANSI & IEC coordination & protection standards
- Phase & ground coordination modes
- Graphically adjustable device settings
- Comprehensive V&V device libraries
- Integrated with one-line diagram
- Intelligent alert view for troubleshooting
- Embedded short circuit analysis
- Embedded motor acceleration analysis
- Modeling of multi-function & multi-level relays
- Graphical combination of protection functions & segments
- Virtual animation of sequence-of-operation playback
- Normalized plots shifted based on fault contributions
- Flexible user-definable display & plot options
- Extensive damage curve modeling & plotting
- Professional time current characteristic plots
- Detailed device setting reports
- Built-in interface with relay test set
- Intelligent protection zone selection and viewer

Protective Device Handling

- High impedance & percentage differential relay (87)
- Phase, ground, & directional overcurrent relay (51/50, 67)
- Detailed implementation of voltage restraint & control relay (51V)
- Comprehensive modeling of electronic & hydraulic reclosers (79)
- Overload relay - CT based & Inline relays (49)
- Comprehensive relay interlocks



One Action Resulting in a Complete Solution

Features

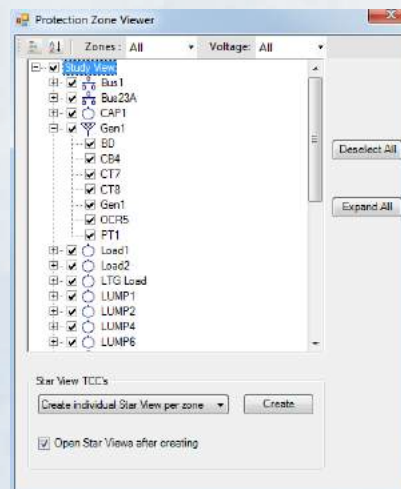
- Illustrate system wide coordination
- Click & drag curves to adjust settings
- Automatic current & voltage scaling
- Customizable curve layout with embedded one-line diagram
- Automatic layout of the one-line diagram in Star TCC View
- Integration of short circuit analysis with protective devices
- Motor starting curves based on motor acceleration studies
- Integration of arc flash analysis results on Star TCC View
- Multi-axis time current curves
- Automated color sequencing of curves
- Graphical curve tracker with cross lines & time gap tools
- Time difference calculator
- Adjustable magnifying-glass zoom view
- User-definable curves & fault arrows
- Transformer damage curve & inrush curve modeling
- Generator decrement & damage curves
- Multiple motor starting curves based on starting voltage
- Motor & stator damage curves
- Automatic clipping of curve based on calculated or user-defined fault current
- Minimum fault calculation & TCC marker
- Comprehensive print functionality, legends, & device labeling
- Batch print TCC plots & diagrams for various paper sizes
- Graphical printing & plotting
- Customizable reports

Benefits

- Enables system engineers to easily & efficiently perform protective device coordination studies
- Provide an accurate & realistic operating characteristic, time, & state of protective devices
- Offers insight into troubleshooting false trips, relay mis-operation, & mis-coordination
- Aids system engineers & planners to quickly realize possible design issues & make informed decisions

Protection Zone Viewer

Protection Zone Viewer (Zone Viewer) provides the tool that defines a path and related zones of protections which will allow the user to create Star Views.



Path Detection Tools

The Path Detection Tools provide an easy way to automatically identify and define a protection / coordination path.



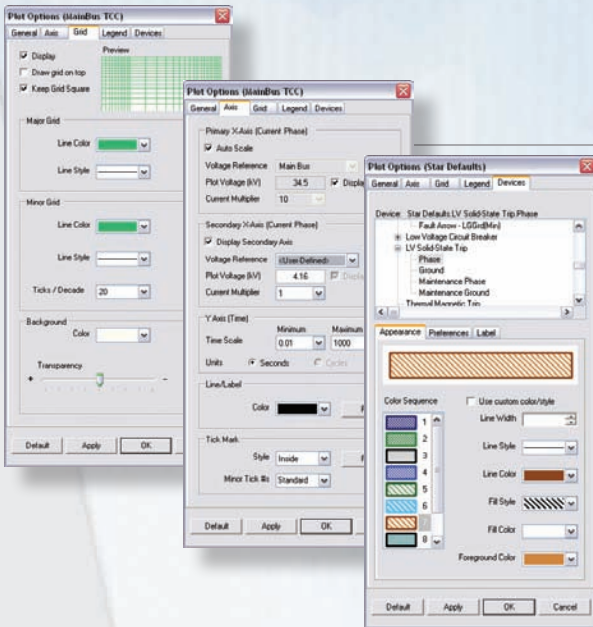
Extend Path to
Nearest Source



Shortest
Connecting Path



Extend Path by
Bus Level

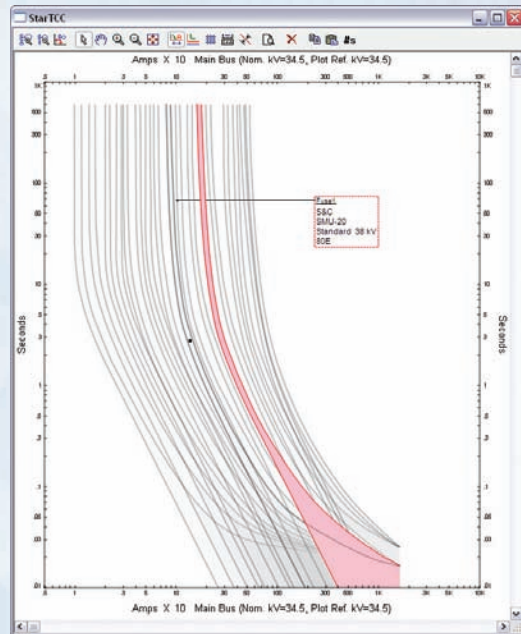


Graphical Adjustment

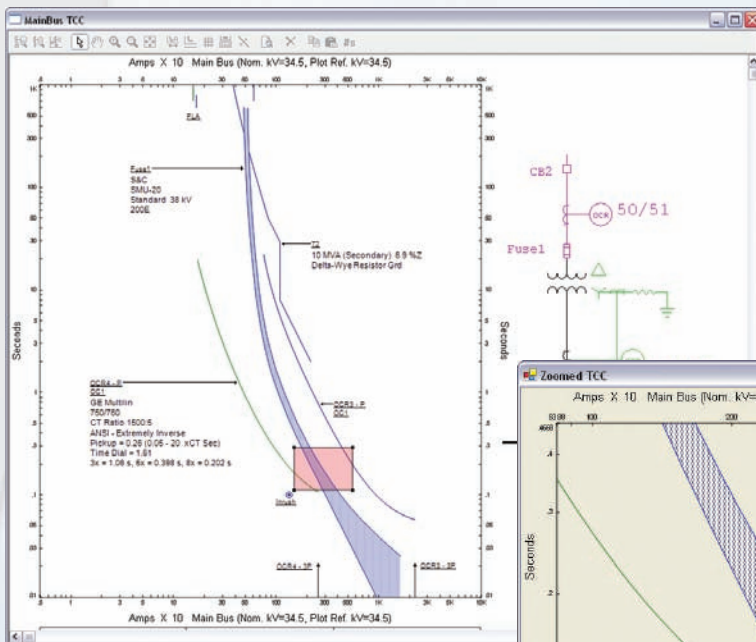
Device curves can be graphically adjusted in the Star View. Handles are provided on the device characteristic curves to identify adjustable regions. Available ranges for a selected curve can be displayed and identified by clicking the Hide/Show Range button. The available ranges are grayed out when an adjustable curve is selected.

Star Plot Options

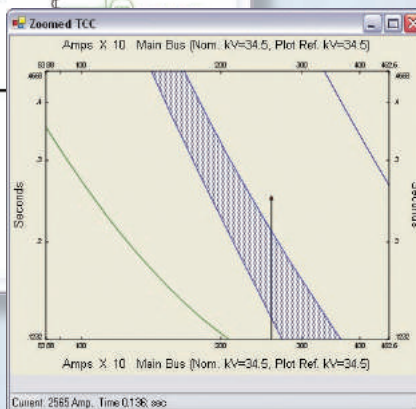
Star Plot Options tool provides all the necessary options to customize the display of the Star TCC curve. You can customize the display of current and time axes, legend, grid, curve plotting properties, and more.



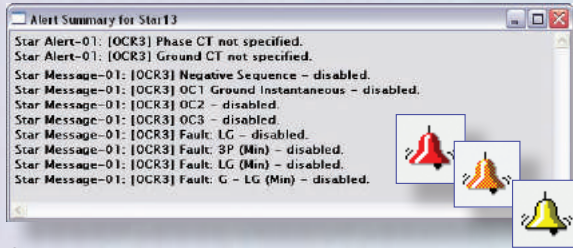
Graphical Adjustment of Curves



Zoom to New Window



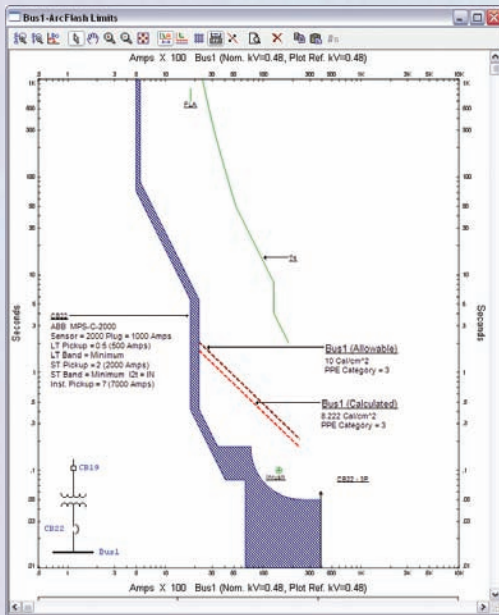
Fully Integrated Module



Star Alert View

Intelligent Alert View

With ETAP Star you can troubleshoot your device coordination studies for any Star View. The Alert View button, on the Star View, provides a summary of alerts or messages (low priority alerts) that provides hints as to how and why a particular device curve is not being displayed or missing information regarding a device.

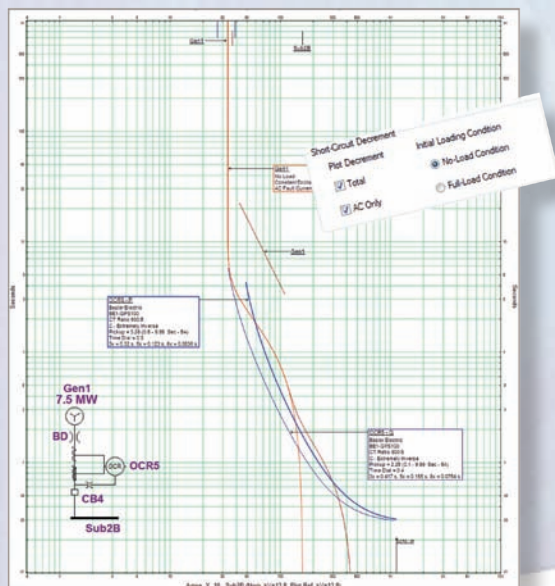


TCC and Arc Flash Results

Integration of Arc Flash Analysis & Star View

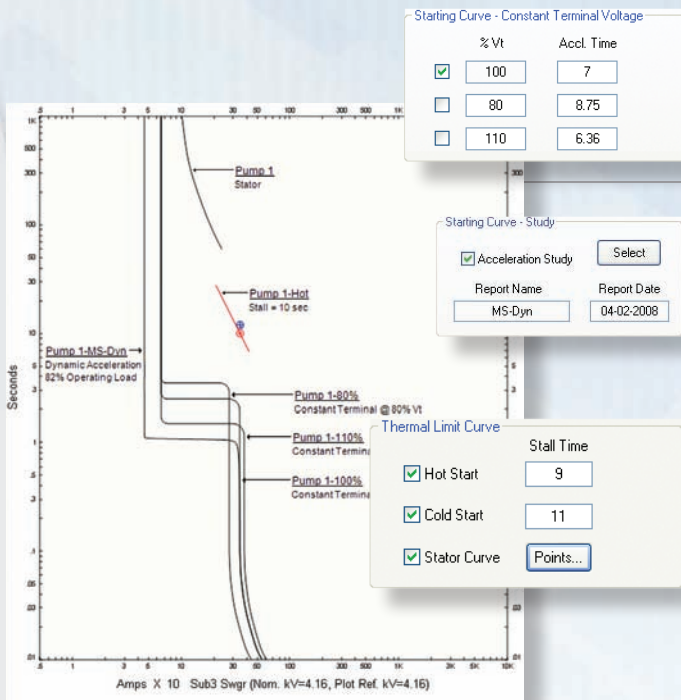
ETAP Arc Flash is a fully integrated module that takes advantage of all the capabilities already built into Star. The program calculates the individual arcing current contributions and arc fault clearing time of all the protective devices involved in the arc fault by interfacing with Star.

The calculated and allowable incident energy curves can be plotted in Star View as a function of time and current.



Generator Decrement Curve

Star provides plotting of the generator decrement curve and display both the symmetrical and asymmetrical decrement curve based on generator no-load or full-load conditions. Excitation system field forcing capability, used to speed up the response of the generator, is also considered when plotting the generator decrement curve.



Motor Starting / Damage Curve

Multiple Motor Starting & Damage Curves

A motor starting curve can be plotted on a Star view for the purpose of determining overload settings for motor protection devices. Constant Terminal Voltage can be used to plot the motor starting curve based on a constant voltage at the motor terminal.

The motor curves have been enhanced by including stator damage curve or running overload curve into Star. Stator curves can be plotted based on multiples of machine full-load amps or actual amp values.

Report: Example BTAP Page: 1
 Location: Irvine, California Date: 07-25-2008
 Contact: OTI-12345678 Revision: Base
 Engineer: Operation Technology, Inc.
 Filename: EXAMPLE.BAT

Protective Device Settings

This info is printed on every output report. Int mark use. (120 characters)

OCR: OC1	Tag#	CT	Base kV	R (A)
MFR: ABB			3000	34.500
Model: DPU-2000R			22.43 7.4k (Flux-Divided)	26.34 5k (Flux-Divided)
			34.500	26.34 5k (Flux-Divided)
			3000	34.500

OC Level: OC1

Phase	TCC	ABNI	Instantaneous	Setting
Phase TOC	Pickup (Tq)	0.4 - 12 Sec - 5A	10.100	
	Time Dial		1.000	
Phase INST	Pickup	0.5 - 40 x I _N	0.200	
	Time Delay	0 - 9.99	0.010	
Overload TOC	ABNI	Instantaneous		
	Pickup (Tq)	0.4 - 12 Sec - 5A	4.600	
	Time Dial		2.100	

Fuse: Fused

MFR:	Tag#	3-Phase kA	21.99	Pgm (Calc.)
MFR: 2MFD20		kV:	38.000	1.0 kA: 23.58 Pgm (Calc.)
Spec: Standard		Int. kA:	39.000	Base kV: 34.500 (Calc.)
Size: 30E		Cont. Amp:	39.000	

CB: CB2

MFR:	Tag#	3-Phase kA	39.22	Appl. (Calc.)
Model: S-2000M		Instanc:	65 kA, 0.40 kV	1.0 kA: 49.12 Appl. (Calc.)
Size: 2000		Cont. Amp:	2000.000	Base kV: 0.400 (Calc.)

LV Solid State Trip Device

MFR:	Tag#	3-Phase kA	39.22	Appl. (Calc.)
Model: MSFC-2000		Instanc:	65 kA, 0.40 kV	1.0 kA: 49.12 Appl. (Calc.)
Size: 2000		Cont. Amp:	2000.000	Base kV: 0.400 (Calc.)

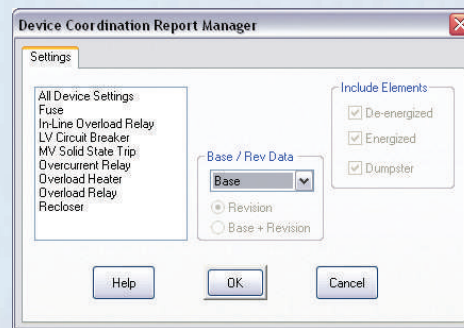
Basic Settings

Long Tm	Pickup	0.5	300	Inst. Delay
Short Tm <th>Pickup</th> <td>1 <td>Instantaneous <td>Flt=0/OT</td> </td></td>	Pickup	1 <td>Instantaneous <td>Flt=0/OT</td> </td>	Instantaneous <td>Flt=0/OT</td>	Flt=0/OT
Inst. Delay <th>Pickup</th> <td>7 <td></td> <td></td> </td>	Pickup	7 <td></td> <td></td>		

Device Setting Report: Customize reports and export to Microsoft® Excel

Device Setting Report

Star Device Coordination Reports Manager provides comprehensive and customizable device setting reports. The manager allows you to preview and print the protective device setting data, using the Crystal Reports® formats.



Star Device Setting Report to Excel.xls

Relay	Manufacturer	Model	CT Ratio	Device Function	Level	Trip Element	Curve	Range	Setting	Primary	Time Dial / Mult.	Range	Setting	Primary	Range	Setting
Relay1	ABB	DRU-2000R	500/5	Overcurrent	OC1	Phase - Extremely Inverse	ANSI - Extremely Inverse	0.4 - 12 Sec - 5A	1.0	100 A	1.0 - 10.0	5.0	10.0 - 40.0	20	2000 A	0.1 - 1.0 sec
Relay1	ABB	DRU-2000R	500/5	Overcurrent	OC1	Phase - Voltage Restraint	Phase - Voltage Restraint	30 - 250 Volts	120.0	4.16 kV						
Relay1	ABB	DRU-2000R	500/5	Overcurrent	OC1	Phase - Voltage Control	Phase - Voltage Control	31 - 250 Volts	120.0	4.16 kV						
Relay1	ABB	DRU-2000R	500/5	Overcurrent	OC1	Phase - Short-Time	Short-Time Inverse	0.4 - 12 Sec - 5A	1.0	100 A	3.0 - 16.0	6.6				
Relay1	ABB	DRU-2000R	100/5	Overcurrent	OC1	Ground	Definite Time	0.4 - 12 Sec - 5A	2.5	50 A	1.0 - 10.0	4	10.0 - 40.0	15	300 A	0.1 - 1.0 sec
Relay1	ABB	DRU-2000R	500/5	Differential	Phase	Phase	Percentage									
Relay2	GE Multilin	269	200/5	Overload	Thermal - Instantaneous	Curve2	Curve2	1.05 - 1.25 xFLA	1.2	77.4 A			4 - 12 xFLA	8	516 A	0 - 20.5 sec
Relay2	GE Multilin	269	200/5	Overload	Acceleration	Start Curve	Start Curve	1 - 1 xFLA	1.0	200 A	0.5 - 125	0.5				
Relay2	GE Multilin	269	200/5	Overload	Jamp	Jamp	Jamp	0.5 - 6 xFLA	2.0	80 A			1.5 - 10	8		
Relay2	GE Multilin	269	200/5	Overload	Ground	Ground	Ground						0.1 - 1 xCT Pri	1	200 A	0 - 20 sec

Sequence-of-Operation

Star Sequence-of-Operation evaluates, verifies, and confirms the operation and selectivity of the protective devices for various types of faults for any location directly from the one-line diagram and via normalized TCC curve views.

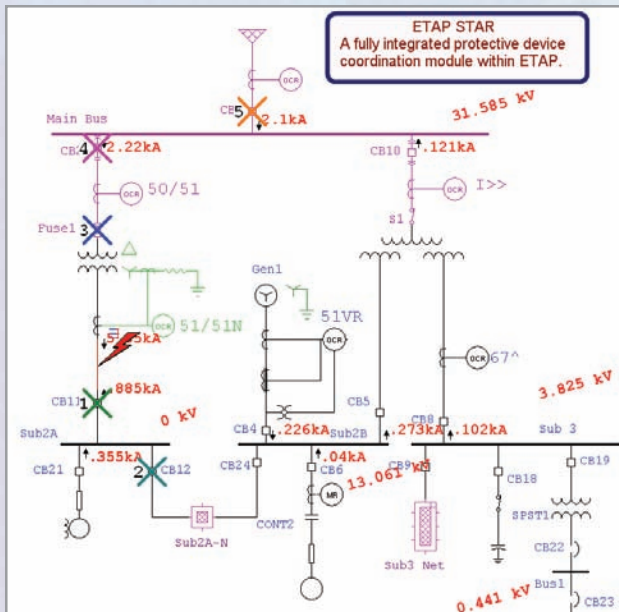
Sequence-of-Operation provides a system-wide solution for an accurate and realistic operating time and state of protective devices, such as relay, fuse, circuit breaker, trip devices, contactor, etc. The operation time is calculated for each protective device based on its settings, time current characteristic, and interlocks for a specified fault location and type.

Functionalities

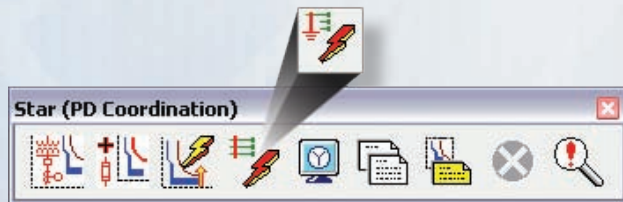
- User-definable fault insertion location
- View device operation sequence graphically
- Device failure & back-up operation
- Detailed relay actions (27, 49, 50, 51, 51V, 59, 67, 79, 87)
- Sequence of event viewer
- Normalized (shifted) TCC curves
- Phase & Ground faults (symmetrical & asymmetrical)
- Flashing protective device via the one-line diagram

Drag & Drop a Fault

- Phase & ground faults
- Display fault currents on the one-line diagram
- Illustrate system wide coordination
- Tabulate operating times via an event viewer
- Customizable reports

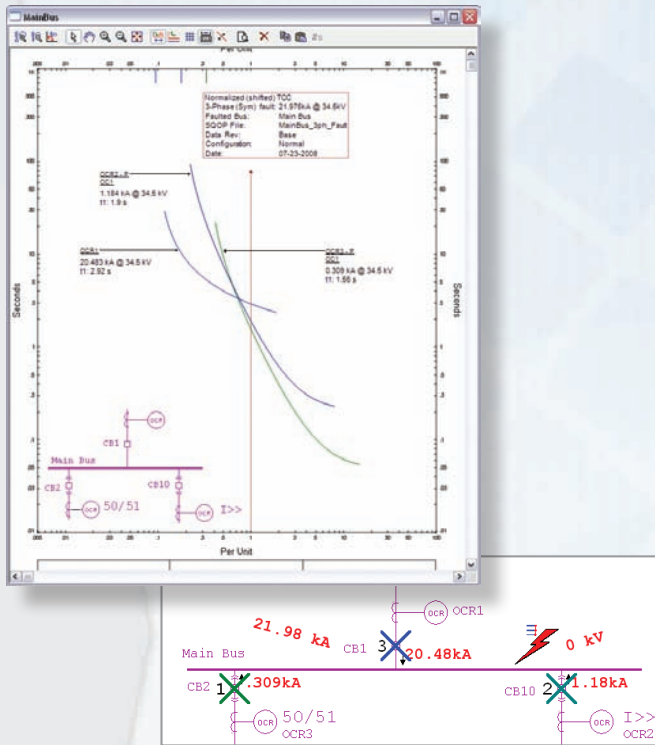


Star Protective Device Sequence-of-Operation



Drag and Drop Faults

Graphical Animation of Protective Device Operation



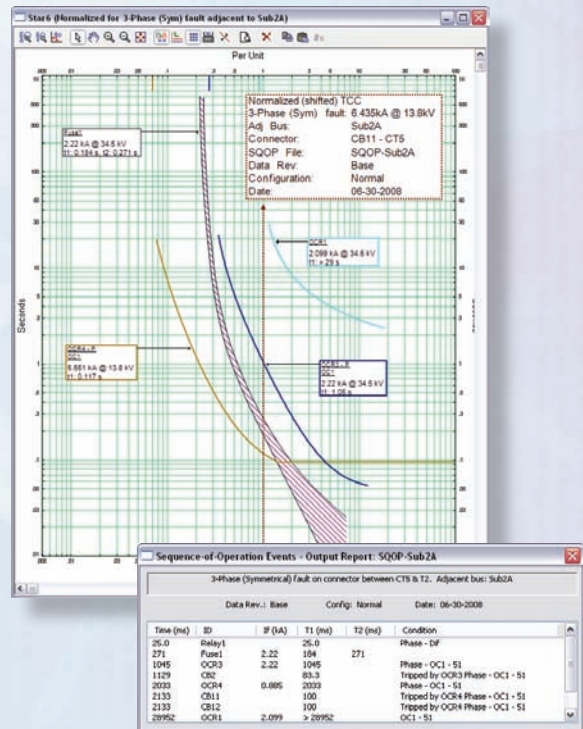
Graphical Animation of Protective Device Operation

Coordinate via One-Line Diagram

- Graphically place a fault anywhere on the one-line diagram
- Automatically calculate & display the fault current contributions on the one-line diagram
- Evaluate the operating time & state of devices based on the actual fault current contribution flowing through each individual device
- Graphical animation of protective device operation
- Globally view post fault actions & associated operating time via a tabulated event viewer
- Examine the operation of protective devices via the one-line diagram

Normalized TCC Curve

Normalized (Shifted) TCC mode is an analysis feature in ETAP Star View, which is based on Sequence-of-Operation calculation. This analysis mode provides a graphical view of the operation times of protective devices based on their corresponding settings and characteristics for specified fault location and type. Normalized TCC mode graphically displays the TCC curves of protective devices in relation to one and another for a given fault.



Normalized Time Current Characteristic Curve

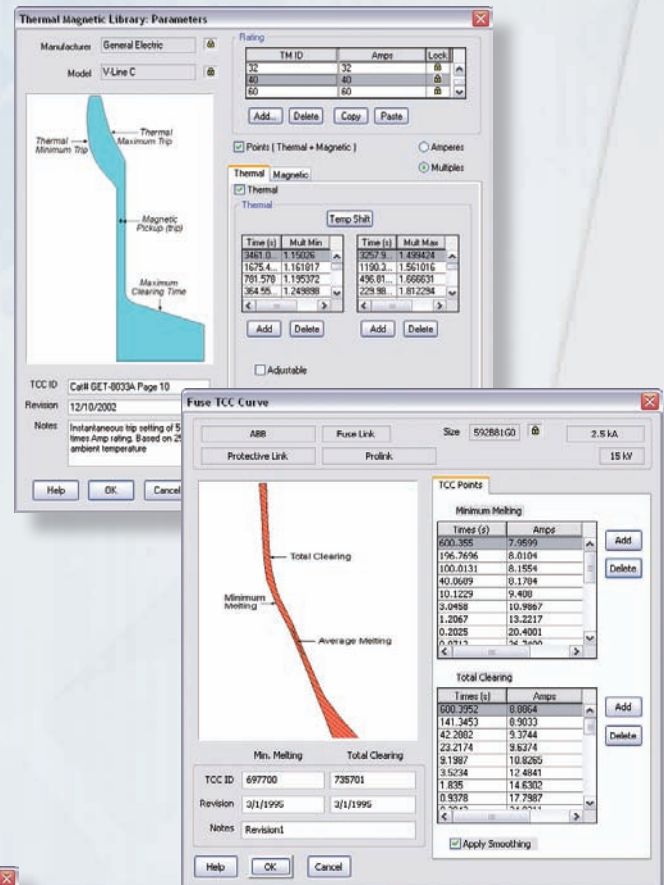
Sequence of Event Viewer

The sequence of operation of protective devices are automatically calculated and listed in an Event Viewer, which is dynamically linked with the one-line diagram. This one-step concept utilizes the intelligent one-line diagram and performs a complete set of actions to determine the operation of all protective devices. This includes internal shifting (normalizing) of each TCC curve based on the individual fault contribution level.

Verified & Validated Device Libraries

Extensive Protective Device Library

- Library copy & merge manager
- Most comprehensive & up-to-date protective device information
- Verified & validated libraries using published manufacturer data
- User-definable libraries – easily create & add new devices
- Digitalization points & equation based relays
- True-to-the-form modeling of protective devices
- Legacy as well as state-of-the-art device manufacturer models
- Customized library – user curve library

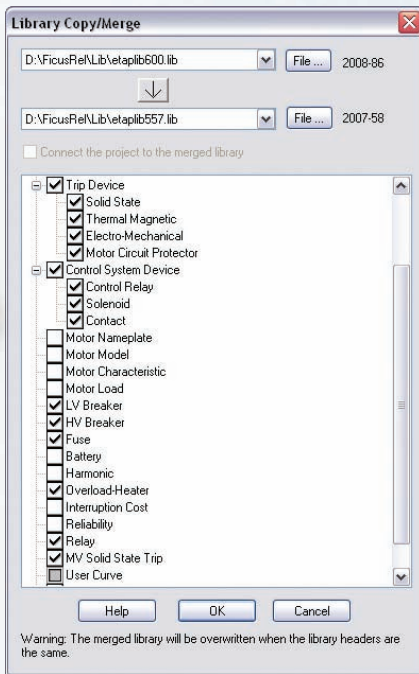


Protective Device Libraries

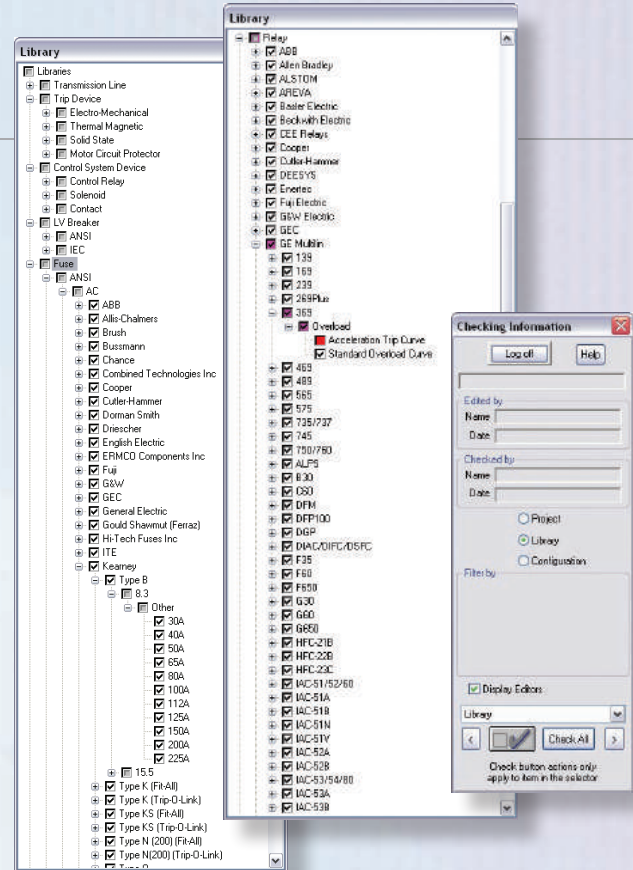
- Fuse
- Relay (OCR, OLR, DIF)
- Recloser
- Electronic Controller
- HV Circuit Breaker
- LV Circuit Breaker
- Solid State Trip
- Electro-Mechanical
- Thermal Magnetic
- Motor Circuit Protector
- Overload Heater

Library Merge

ETAP allows merging of library files using the copy and merge functions. The merge function allows you to merge a partial or complete library file from one to another, making it simple to manage the content from various library files.



Library Merge Manager



Library Checker: Track and verify library changes

Library Checker

The checker access level is provided for verification of changes to project engineering properties and libraries data. This allows for control and validation of library data.

Accuracy & Reliability

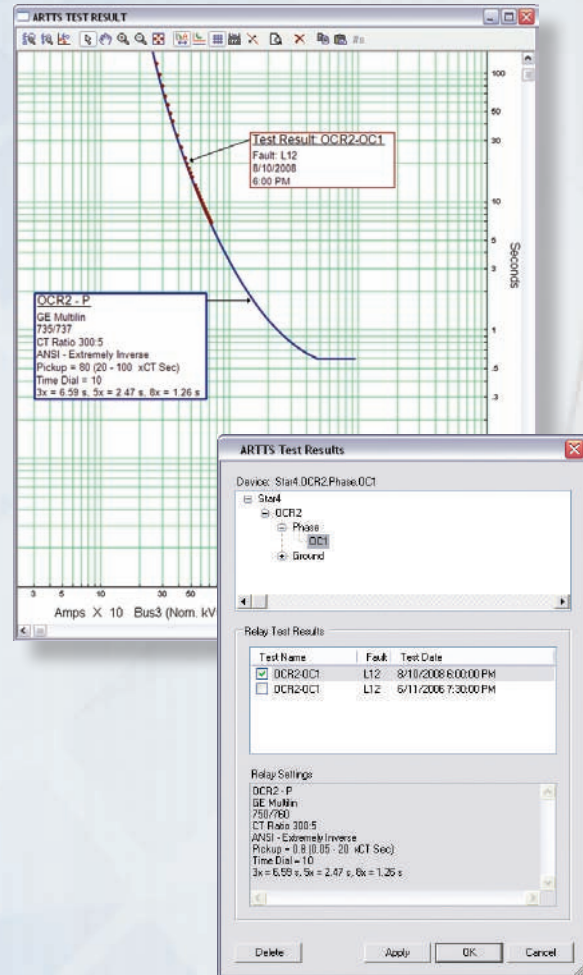
ETAP is a high-impact electrical engineering software to comply with widely accepted and firmly established quality standards and regulations. Every release of ETAP is verified and validated (V&V) against field results, real system measurements, established programs, and hand calculations in order to ensure its technical accuracy. The V&V process includes the entire ETAP Library including the device libraries.

Precise, Flexible, Accurate

Relay Testing Interface

The ETAP Advanced Relay Testing and Transient Simulator (ARTTS) interface combines the short-circuit and protection device coordination capabilities of ETAP with the relay testing hardware. It provides actual steady-state and transient responses of relays for comparisons with the manufacturers published data.

- Fully integrated protective relay historical testing & maintenance database with ETAP Star
- Export short circuit data, relays settings to relay test set
- Plot device steady-state response
- Compare relay response with manufacturer published data
- Analyze deviation from nominal values
- Display relay actual transient response
- Analyze relay false trips & mis-operation
- Comtrade export of time domain fault currents & voltages



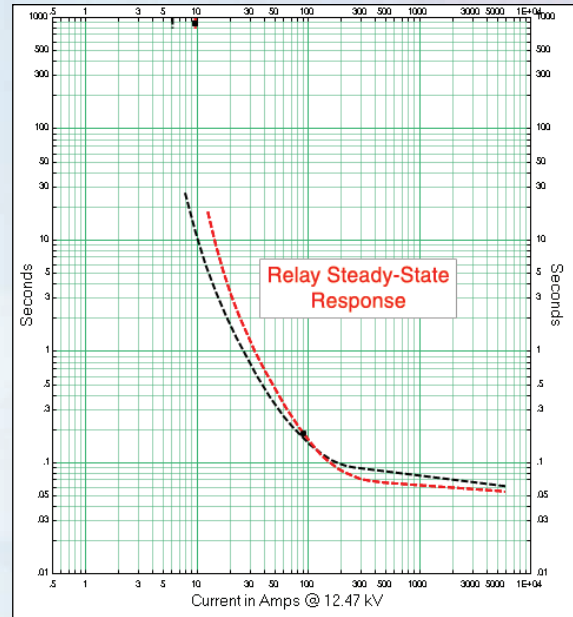
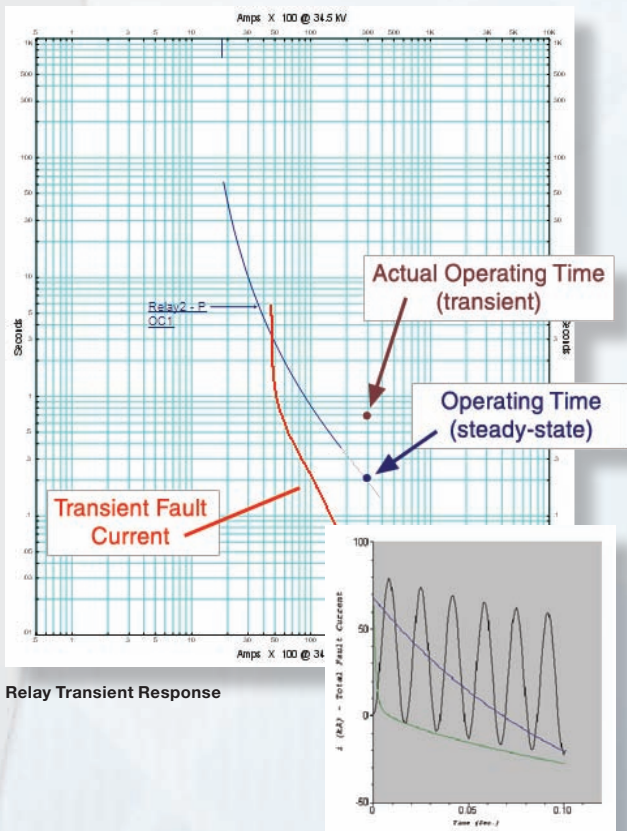
Test Results Comparison: Compare test results with published curves



Relay Actual Response

Steady-State Response

ETAP Star exports the relay settings and parameters for current injection into the relay. Based on the required range of the overcurrent and/or fault current, the relay test set injects multiple currents (single-phase or three-phase) into the relay in order to reconstruct the relay TCC curve based on the actual relay response. Test points are then imported to ETAP Star for plotting and comparison with the manufacturer published data.



Relay Steady-State Response

Transient Response

The ability to simulate relay response under steady-state and transient conditions, during both fault and normal system operating conditions, provides the necessary tools for protection engineers and technicians to confidently determine and evaluate the design and operation of protection system. Steady-state fault current provides only a snapshot operation of the relay based on sustained current. Transient fault simulation is necessary to determine the actual response time of the relay based on the distributed through fault containing AC and DC decay current.

The waveforms are generated from ETAP and are pragmatically played into the relay through. This allows for verification of the relay operation under conditions matching actual system faults. By comparing these sets of curves, Star visually indicates the discrepancies and deviation between the actual (field setting) versus design (intended / ideal) device response characteristics.

etap.com

Quality Assurance Commitment

ETAP is Verified and Validated (V&V) against field results, real system measurements, established programs, and hand calculations to ensure its technical accuracy. Each release of ETAP undergoes a complete V&V process using thousands of test cases for each and every calculation module. ETAP Quality Assurance program is specifically dedicated to meeting the requirements of:



ISO 9001:2009

10 CFR 50 Appendix B

10 CFR 21

ANSI/ASME N45.2

ASME NQA-1

ANSI/IEEE 730.1

CAN/CSA-Q396.1.2

ANSI N45.22

© 2011 Operation Technology, Inc. All rights reserved. Certain names and/or logos used in this document may constitute trademarks, service marks, or trade names of Operation Technology, Inc. Other brand and product names are trademarks of their respective holders.

B20-SDC-0911-10