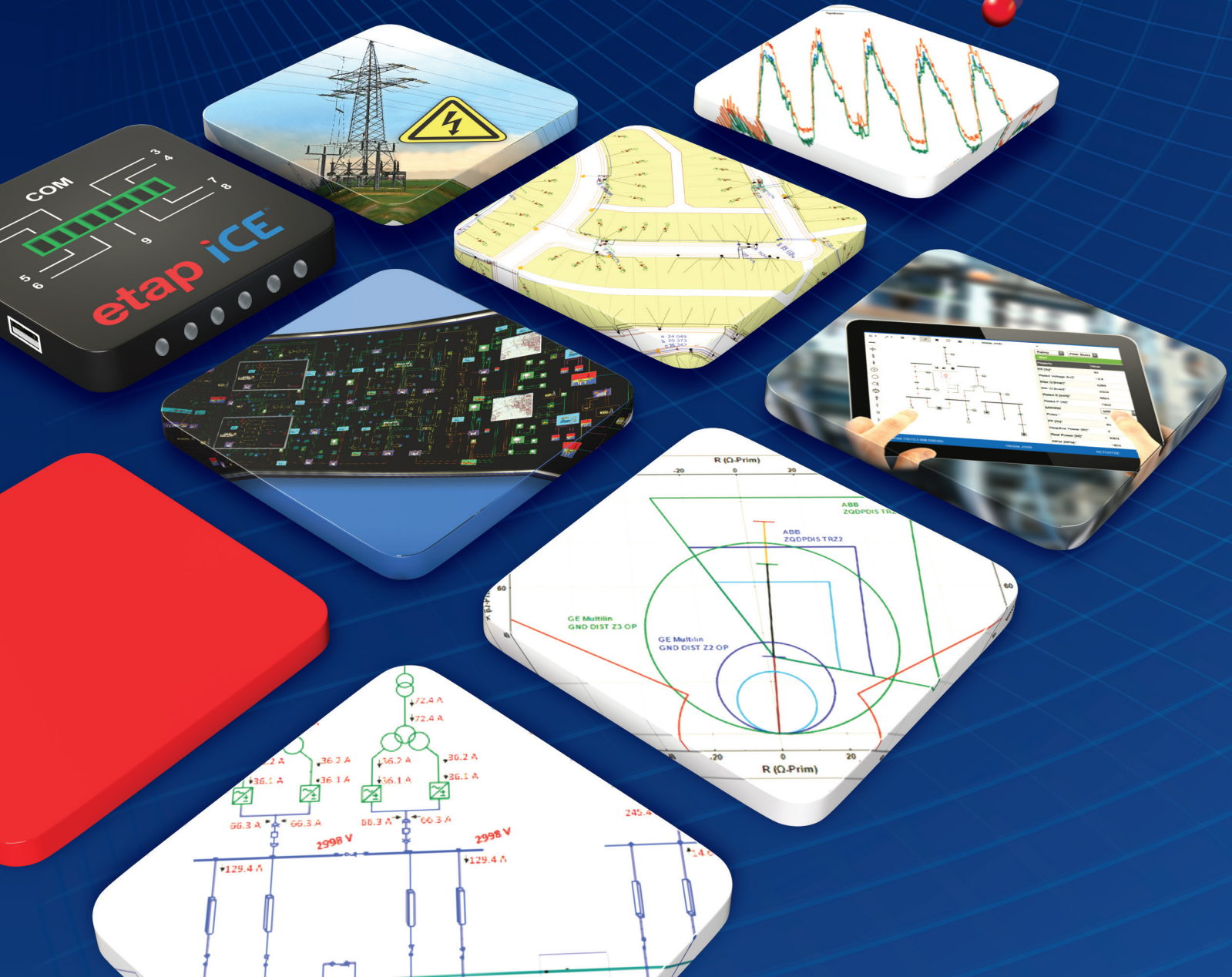


# etap<sup>®</sup> 18

Convergence of Power & Intelligence



## Features & Capabilities



**Intelligent System Modeling & Network Management**

etapAPP™, Plot Manager, New Elements & Libraries

**Advanced Power System Analysis Modules**

Time Series Power Flow, ArcFault™, Distance Relay Protection, Renewable & Microgrid, eTraX™

**Innovative Power Management & Automation Solutions**

Advanced Distribution Management System, Switch Order Management, SCADA Protocols, Dashboard Views

**Major Capabilities *New***



**etap iCE™ - Intelligent Control Enterprise Hardware**

Programmable control and Remote Terminal Unit hardware integrated with ETAP applications. Verified & Validated with ETAP Real-Time™ solutions for optimal performance, fast response, and cyber security.



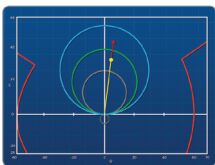
**etapAPP™ - Field Data Collection & Synchronization**

ETAP application designed for field data collection & simultaneous user project management that synchronizes information with ETAP.



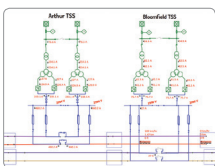
**ArcFault™ - Arcing Fault Hazard Evaluation**

LG, LL & 3-phase arc fault analysis for systems up to 800 kV. New module provides incident energy results for open air and enclosed equipment with bolted fault currents up to 60 kA.



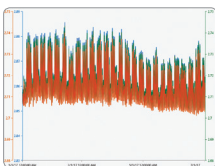
**StarZ™ - T&D Protection & Coordination**

T&D network protection & coordination software to examine the performance of relay functions including Distance, Directional, Load Encroachment & other protective devices.



**eTraX™ - Rail Traction System**

Most accurate, user-friendly & flexible software tools for analyzing, managing, and simulating low & medium voltage train power systems.

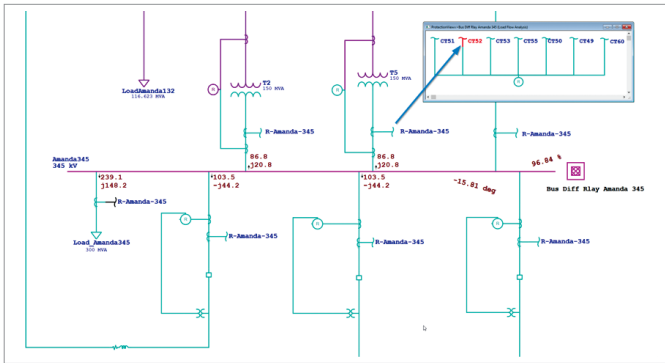


**TDLF - Time Domain Load Flow**

Solve power flows based on time-varying load & generation for 3-phase, 2-phase, 1-phase AC & DC networks simultaneously in radial or looped configurations.

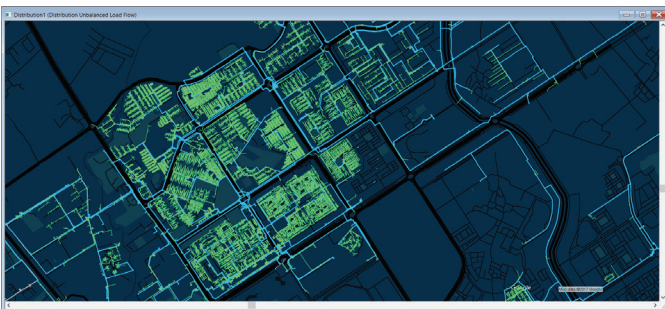
## One-Line Diagram

- Enhanced auto-build & layout
- Enhanced batch print & zoom views
- Synchronized presentation views
- Region classifications & coloring *New*
- Paste data to multiple elements *New*
- Remote connectors
  - Support remote connection for CT & VTs *New*
  - Split-differential protection schemes across nested networks *New*
  - Avoid intersections for multiple input configuration



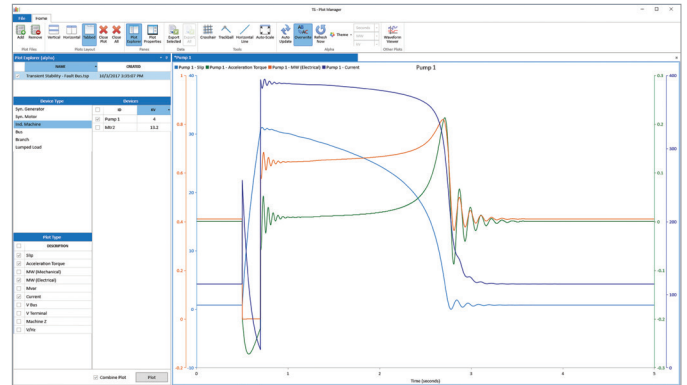
## Geospatial Diagram

- Intelligent Geospatial Diagram
- Feeder & Substation Diagrams *New*
- Geospatial model manager
- Import from third-party geodatabases
- Synchronized with one-line diagram
- Download background maptiles from Bing or Google Maps using ETAP MapServer™ (requires API key)
- Edit Geospatial Diagram similar to the one-line diagram, such as add, modify, & reconnect elements
- Circuit & feeder tracing
- Decluttering, color themes, user-defined symbols
- Graphical display of study results & alerts
- Study result & alert animation
- Automatic incremental updates



## Plot Manager *New*

- Plot & view results from multiple studies
- User-configurable plots & settings
- Customize properties & save as template
- Works with all ETAP modules
- User-defined application styles
- Automatic data fit to plot
- Automatic label layout
- Zoom, pan, tile, etc.



## Datablock

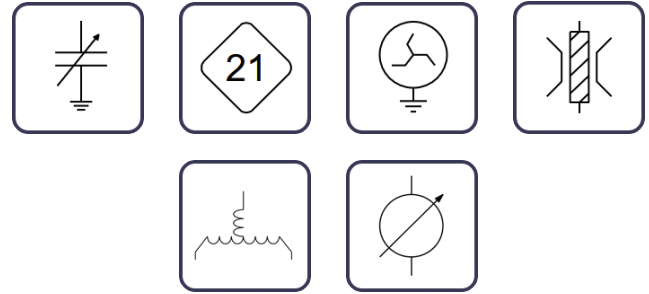
- Expanded input data & study results
- Arc Flash results *New*
- Display results, input, tags
- User-defined templates
- Auto-adjusting protective device settings
- Independent tooltip & display *New*
- Duplicate datablocks across multiple views

## ETAP Application

- Installation Wizard *New*
- Keyless License Manager
- Ribbon bar for Ground Grid & Cable Pulling *New*
- Windows Active Directory authentication *New*
- Library defragmentation & compaction *New*
- Improved performance & analysis run-time *New*

## Elements *New*

- **Series Capacitor**
  - User-selectable capacitor location
  - Calculate degree of compensation
  - Consider MOV protection & bypass
- **Switched Capacitor**
  - Automatic control modes: voltage, current, power factor
  - Control buses & branches
- **Distribution Voltage Regulator**
  - Automatic control modes: forward, reverse
  - Include Line Drop Compensation (LDC)
  - Per-phase voltage regulator adjustment
  - Control based on load side voltage requirements
- **ZigZag Grounding Transformer**
  - Consider effect in unbalanced studies & harmonics
  - Alert based on nameplate rating
- **Traction Power Elements**
  - Rectifier - Controlled & uncontrolled
  - Transformers - Booster, Auto, Scott-T
  - Speed, elevation, signal, etc.
  - Insulator & isolators
- **Distribution Elements**
  - Jumper, cut & open point
  - Distributed load
- **Busway (trunking busbar)**
  - User-defined or typical impedance
  - Alert based on nameplate rating



## Rule Book - Harmonic Compliance Limits *New*

- ANSI/IEEE 519-2014
- IEC 61000-3-6: 2008
- User-defined grid code & local standards

Harmonic Rulebook Editor: ANSI/IEEE519-2014/North America

Info | Voltage | Current | Interharmonics

Data

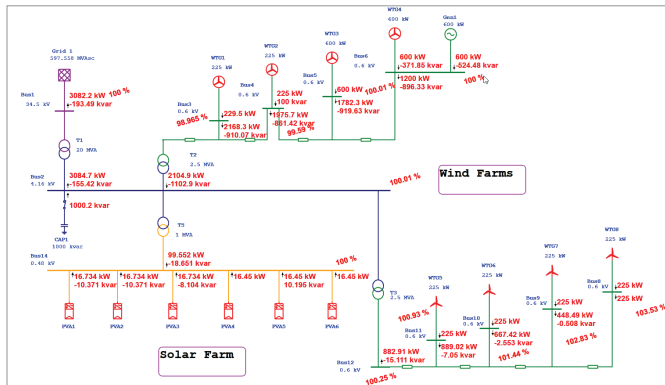
Fund. Current: 100 Amp | Fund. Freq: 60 Hz | Max Order: 50 | Harmonic Order: 11

h	Hz	IsdL for kV ≤ 1					IsdL for kV ≤ 69
		<20	20-50	50-100	100-1000	>1000	<20
THD	60	5.000	6.000	12.000	15.000	20.000	5.000
2	120	1.000	1.750	2.500	3.000	3.750	1.000
3	180	4.000	7.000	10.000	12.000	15.000	4.000
4	240	1.000	1.750	2.500	3.000	3.750	1.000
5	300	4.000	7.000	10.000	12.000	15.000	4.000
6	360	1.000	1.750	2.500	3.000	3.750	1.000
7	420	4.000	7.000	10.000	12.000	15.000	4.000
8	480	1.000	1.750	2.500	3.000	3.750	1.000
9	540	4.000	7.000	10.000	12.000	15.000	4.000
10	600	1.000	1.750	2.500	3.000	3.750	1.000
11	660	2.000	3.500	4.500	5.500	7.000	2.000

Buttons: Delete, Insert, Help, OK, Cancel

## Elements - Dynamics & Safety Modeling

- Busbar
- Inverter
- Wind Turbine Generator
- Photovoltaic Array Inverter
- HVDC - Voltage Source Converter (VSC)



## Engineering Libraries


- Distance relay *New*
- Distribution transformer *New*
- Train rolling stock *New*
- Traction rectifier library *New*
- Sector & profile library
- Over 450 new V&V protective device models
- Over 40 detailed distance relay models with manufacturer-specific settings


## Equipment Warehouse

- Overhead line – phase, ground, tower/pole
- Overhead catenary
- Power cables
- Distribution transformer
- Low-voltage circuit breakers
- Power fuses
- Railway track
- Equipment reliability


## Collection & Verification

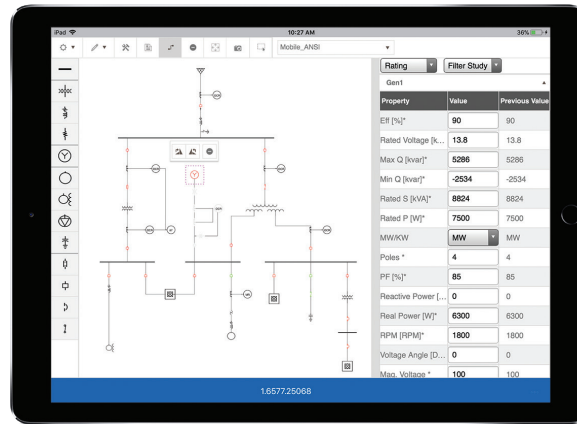
- Collect data, verify existing data & transfer to ETAP
- View ETAP data on mobile device
- Create new one-line diagrams on mobile device or append to existing
- Smart connections including auto-insert
- Layered diagram using composite networks


 **One-Line Diagram**  
Complete or subsystem network


 **Smart Connect**  
Auto-insert devices without breaking connections

 **Smart Touch**  
One finger & two finger actions


 **Composites**  
Nested one-line diagram using composite networks



 **Data Access**  
User-based data access & synchronization

 **Camera**  
Capture pictures & link to ETAP model

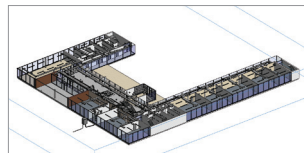
 **Data Connection**  
Wireless connections & synchronization

 **Components**  
View, edit & verify data using property data grid views

## Data Exchange - DataX™

### Autodesk Revit® *New*

- Import Revit drawings to ETAP
- Supports incremental Revit model import
- Support for RVT v2017 – v2019
- Identify & alert modeling issues
- Auto-generation of one-line diagram
- Smart Connect: Revit Plug-in to ETAP



### ArcGIS® Import & Export *New*

- Import ESRI ArcGIS electrical information
- Map ArcGIS attributes with ETAP elements & properties
- Database mapping via graphic user interface
- Export ETAP GIS electrical data to XML
- Support for ESRI ArcGIS 10.x

### EMTP - Electromagnetic Transient Program *New*

- Dedicated module for EMT analysis
- Export ETAP electrical data to PSCAD® & EMTP-RV
- Automatic mapping of attributes

### Model Conversion from SKM PTW *New*

- Detailed built-in conversion tool from SKM PowerTools®
- Converts SKM PTW versions 6.x to 8.x
- One-line diagram conversion based on original layout
- Data consistency checking & validation
- Automatic protective device settings mapping
- Create & save device library mapping as templates
- Import of user-created Time-Current Characteristic (TCC) curves
- Support for multiple one-line drawings and MCCs into composite networks

### MultiSpeak® *New*

- Import & export power system data
- User-defined mapping of elements & properties
- Supports MultiSpeak v3.0 & v4.0

### Universal Mapping *New*

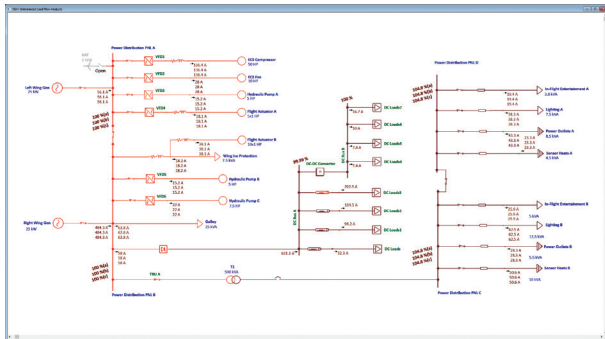
- Powerful element & property mapping
- Customizable logic & pre-defined power functions
- Supports CIM, ESRI ArcGIS, MultiSpeak, MS Excel

### Common Information Model, CIM *New*

- Import & export data from ETAP using CIM XML
- User-defined mapping of elements & properties
- IEC 61970 & IEC 61968 standard

**Unified Power Flow** *New*

- Solve AC & DC systems together
- Solve LV power panel, UPS circuits & facility network simultaneously
- Handle load & source connection below panel
- Allows for panel & UPS loop connections
- Enhanced current limit modeling for inverters
- Optimized for multi-core CPU



**TDLF - Time Domain Load Flow** *New*

- Simultaneous time series simulation of AC & DC networks
  - Demand & generation
  - Diversity factor, demand factor, unbalance factors, etc.
  - Voltage drop, energy losses, yield, and costs
- Time series behavior of adjustable devices
  - Transformer load tap changers
  - Switched capacitor
  - Voltage regulator
- Single & multi-year load growth analysis
- Irradiance, temp & load profile library

**Harmonics & Power Quality**

- Compliance with power quality standards
  - IEEE 519-2014
  - IEC 61000-3-14
  - IEC 61000-3-6
- Global, local & individual location compliance rule book for voltage & current distortion
- New skin effect models for motors & transformers
- Enhanced current distortion alerts
- Automatic TDD current distortion limit evaluation
- Enhanced voltage & current alerts with percentile multipliers
- Enhanced load equipment cable modeling

**Star™ - Protection & Coordination**

- Up to 6 settings group with labels & copy/paste *New*
- Sorting & filtering for device settings report *New*
- Settings report based on substation / bus ID *New*
- Globally include one-line diagram during batch print
- Expanded current & voltage inputs
- Phase current summation
- Ground & neutral protection for overload function

**Motor Starting**

- Enhanced inverter model
- Plot Manager interface *New*

**Short Circuit**

- Compliance with IEC 60909-2016 Ed. 2.0 *New*
- Variable fault current vs. voltage
- LV to EHV system fault current calculation

**Reliability Assessment**

- Reliability warehouse *New*
- Multiple-phase configurations
- GIS system element handling
- Unbalanced system reliability calculation
- Reliability new indices
  - CTAIDI *New*
  - ALII *New*
  - ACCI *New*
- Reliability momentary indices
  - MAIFI *New*
  - MAIDI *New*
- Optimized for multi-core CPU

**Transient Stability**

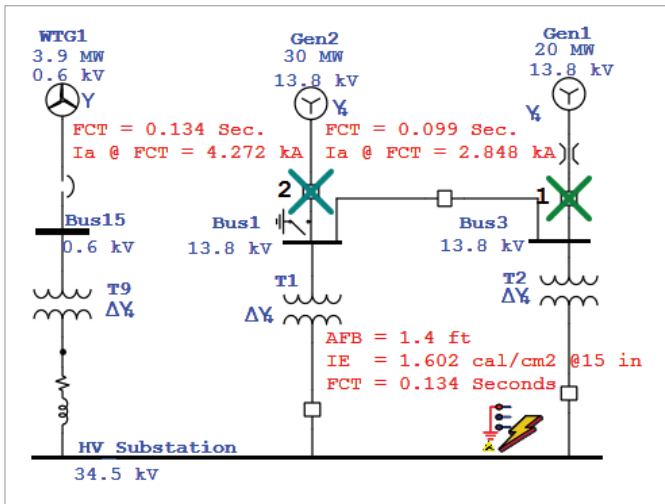
- Line-line & line-line-ground fault actions *New*
- Improved synchronous machine saturation modeling
- Enhanced frequency-dependent network & generator models
- Enhanced Motor Parameter Estimation & Tuning (MPET)
- Enhanced built-in excitation system models

**LV & Cable Systems**

- Ground Grid & Cable Pulling user interface
- User-defined Final Temperature for cable damage curve plotting *New*

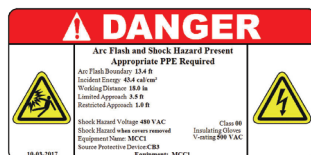
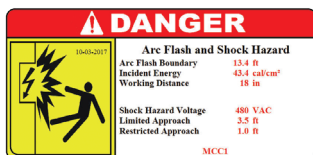
## ArcFault™ - NESC C2 - Up to 800 kV *New*

- Arcing fault hazard evaluation
- Model line-ground & line-line arc faults in open air
- Model 3-phase arc faults in open air
- Protective device sequence of operation for line-ground, line-line & 3-phase arc faults
- Auto-gap, working distance & auto-selection of minimum approach distance per NESC C2 2012/2017
- Minimum approach distance with or without tools
- Altitude & transient overvoltage correction factors
- Automatic or user-defined distance parameters
- Integrated with Arc Flash Result Analyzer
- Customizable coefficient editors
- User-definable PPE requirement editor
- Auto-update for worst-case incident energy
- Global or individual typical input data
- Integrated with Arc Flash datablocks
- Verified & Validated against industry standards



## Arc Flash - IEEE 1584 & NFPA 70E

- Compliance with NFPA 70E 2018 standard *New*
- Customizable X-factors based on IEEE 1584-2002
- Inverter modeling for renewable systems *New*
- Label formats for arc flash boundaries (ft.in, ft, in) *New*
- Enhanced reports & labels for 64-bit MS Office
- User-defined arc flash boundary threshold
- Enhanced one-line diagram annotations
- Arc Flash Result Analyzer fields *New*



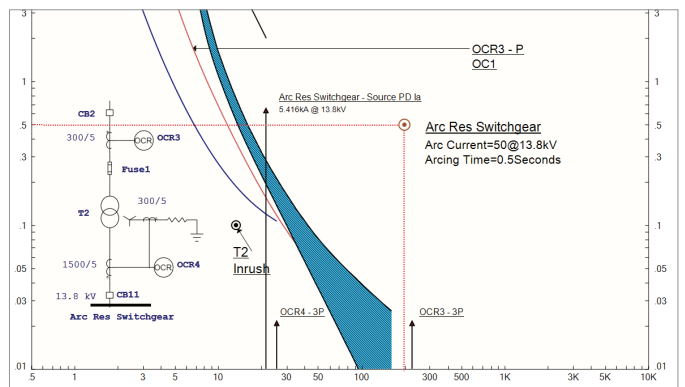
## Arc-in-a-Box - 15 to 36 kV *New*

- Extended IEEE 1584-2002 model for 'Arc-in-a-Box'
- Typical and user-defined gaps between conductors
- Conversion factors from High Voltage Arc Flash (HVAF) to Arc-in-a-Box
- Incident energy reflectivity factors for box size
- Enhanced arc flash analysis data for equipment > 15 kV
- Designed for HVAF in renewable energy collector systems



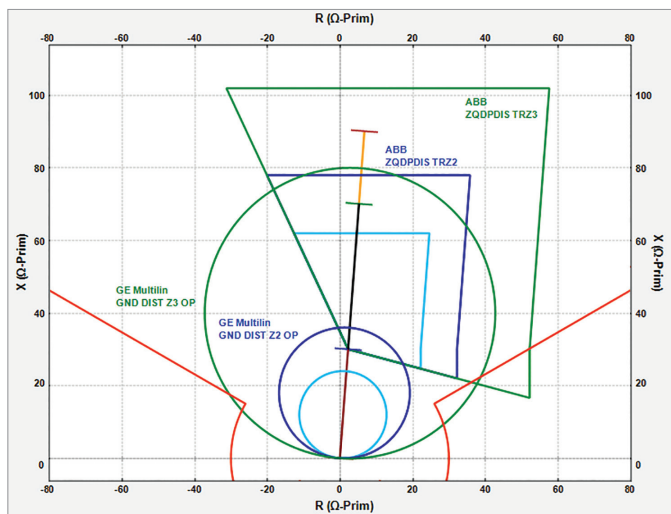
## Damage Point for Arc Resistant Switchgear *New*

- Maximum arc current indicator & label
- Maximum arcing duration indicator & label
- Show arc resistant switchgear damage point on Star TCC plots
- Evaluate margin with actual arc current on TCC plots for compliance with IEEE C37.20.7-2007
- Designed-based on IEEE PCIC-2017-03



### Protective Relay Performance & Evaluation

- Simulate model-specific protection settings & functions including distance, directional & load encroachment
- Plot R-X characteristics & seen impedances
- In-depth performance evaluation of impedance relays
- Evaluate protective device operation & coordination
- Intelligent alert viewer to identify & resolve setting & logic errors
- Virtually animate protective devices operation
- Breaker failure & relay communication
- User-editable scheme logic
- Use real-time operational data for system evaluation
- Intuitive relay setting editor
- Primary & secondary relay settings based on actual model
- Comprehensive relay library



### Embedded Fault Analyses & Power Flow

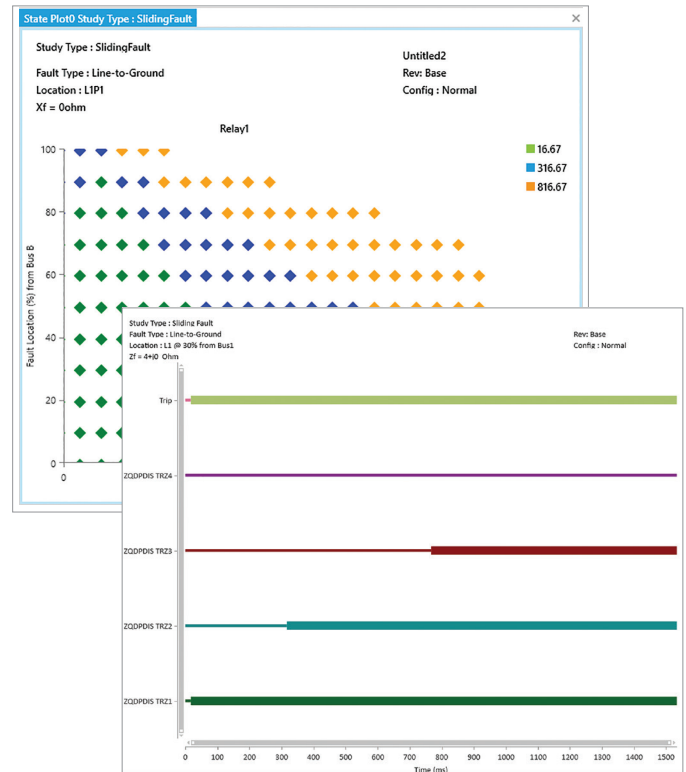
- Sliding fault analysis
- Single fault analysis for unbalanced networks
- Unbalanced load flow & transmission line load-ability analysis
- Protective device sequence-of-operation
- Data communication between relays & interlocks
- Fault insertion between CT, VTs & CBs
- Multiple fault locations & resistances analysis in one-click
- Series compensated line evaluation with MOV protection
- Support mutually coupled lines & single-phase systems

### Plots & Reports

- Time state plots
- Time distance characteristic plots
- Time distance-resistance characteristic plots
- Detailed device setting reports
- Export relay settings to xml & Excel formats

### Distance Relay

- Distance function
- Scheme logic (input, output, timer, latch, variables)
- Expanded current & voltage inputs
- Digital inputs
- Phase current summation
- Up to 6 setting groups with labels & copy/paste



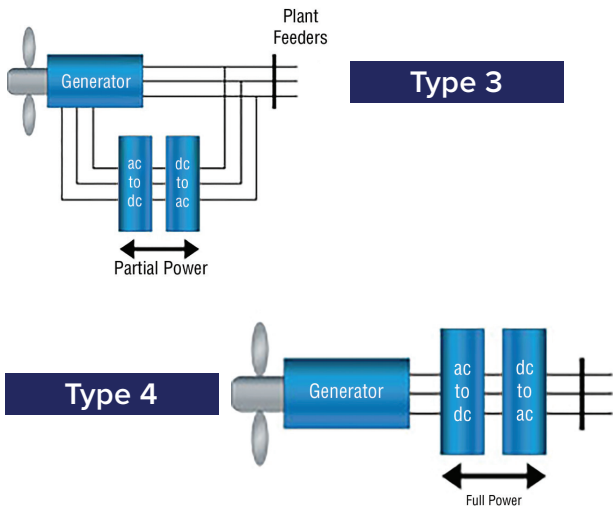
### Distance Relay Library

- Detailed distance protection element for over 40 relay models:
  - Schweitzer
  - GE Multilin
  - ABB
  - Schneider
  - Alstom/Areva
  - Siemens
  - ZIV
  - ERL Phase
  - ARCTEQ
  - Toshiba
  - Universal (Generic)



## Wind Turbine Generator (WTG)

- Dynamic models based on IEC 61400-27-1-ed1 *New*
  - Type 3A
  - Type 3B
  - Type 4A
  - Type 4B
- Short circuit modeling per IEC 60909-2016 *New*
- Crowbar & current limit short circuit model with active & reactive *New*
- Auto-trip voltage & duration for LVRT



## Microgrid Modeling

- Transient Stability (TS) to User-Defined Dynamic Model (UDM) network control signal types
- Internal or external inputs from:
  - Power system stability network
  - Real-time input measurements or tags
- TS voltage & power flows from network can be accessed by UDM Microgrid Controller
- User-defined renewable energy models for Wind Turbine Generator & Photovoltaic Array *New*



## Solar/Photovoltaic Inverter Modeling

- Current limit model for short circuit
- Reactive & power factor control with constant current limitation
- Minimum & maximum operating values for current limits
- Low-Voltage Ride Through (LVRT) auto-trip voltage & duration for incident energy reduction
- Enhanced current limit modeling for inverters
- Inverter modeling for Arc Flash in renewable energy systems *New*



## Transient Stability

- Line-to-line fault event simulation
- Line-to-line-to-ground fault event simulation
- Improved synchronous machine saturation model
- Enhanced built-in excitation systems
- Enhanced frequency-dependent network & generator modeling
- Microgrid Controller network parameter inputs to UDM *New*
- Improved inverter transient response
- Enhanced UDM model library
- Plot Manager interface *New*

**Short Circuit Current**

Crowbar Activated Under Fault

ANSI Short Circuit  
Crowbar & Dropper Resistance: 40 %

IEC Short Circuit  
IWDmax: 350 % FLA  
kWD: 1.7  
RWD: XWD: 0.1  
μWD: 1.03  
kWDmin: 150 % FLA  
kWDmin: 100 % FLA

Auto Trip  
Trip Time: 0.2 sec  
VshLcd: 50 %

**Rating**

MW	kV	% PF	% EFF	Poles	RPM
1	0.6	85	95	4	1800

MVA: % of Nominal Bus kV: 100  
T: 1.176  
T132

MVar Units:  Wind Speed  10 m/s  Controller  User-Defined

Normal Operating Voltage: Vmax: 90 % Vmin: 110 %

Wind/Gen Category	% Generation	s/V	MW	Qmax	Qmin
1 Design	100	100	1	0.4	-0.1
2 Normal	90	100	0.9	0.35	0

### AC & DC Railway Simulation

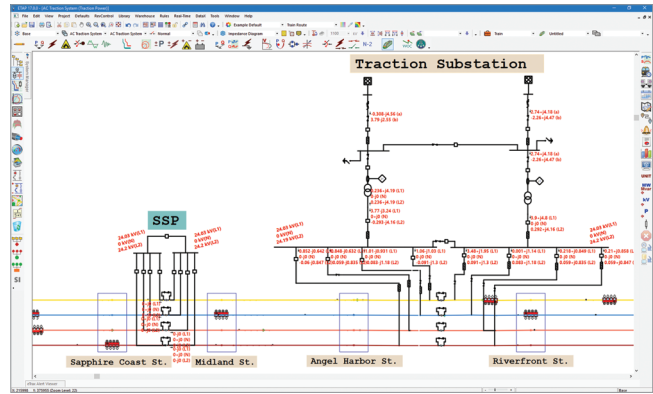
- Tool for analysis & operation of tractions systems
- Solve transmission, distribution, traction, & signaling together
- Integrate GIS, planning, protection & operations
- Energy demand calculation based on train timetables
- Resolve challenges of unbalanced system operation
- Evaluate substation location & capacity
- Determine the impact of various rolling stock
- Determine capacity restrictions & analyze mitigation methods
- Determine impact of unplanned events on the traction power system using real-time data
- GIS for overhead catenary system
- Data exchange with third-party applications & templates
- Traction power equipment templates
- Utilize real-time data for Energy Forecasting & Switching Management
- Verified & Validated (V&V) against benchmarks

### Traction Elements

- Overhead Catenary System
- Track Resistance
- Traction Substation (TSS) & Switching Station (SSP)
- Traction Rectifier - Controlled & Uncontrolled
- Train Station & Platform
- Insulator, Insulated Overlap, Neutral Section & Isolator
- Substation & Traction transformers
  - Auto-transformer
  - Booster-transformer
  - Scott-T transformer
- Signal, Speed Limit, Level Crossing
- Distance, Elevation & Bend Radius

### Traction Analysis

- Train Performance Calculation
- Solve unbalanced AC & DC systems together
- Unified AC & DC Time Series Power Flow
- Optimized for multi-core CPU

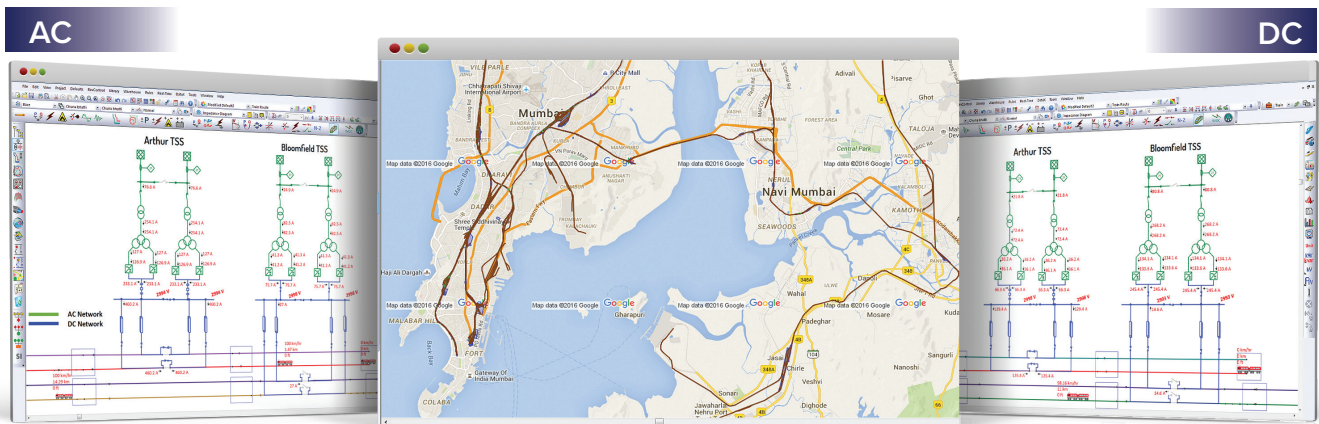


### Interface

- Track Editor & Warehouse
- Line Editor & Warehouse
- Route & Timetable Editor
- Automatically generate train timetable based on number of trains, head-way, dwell time, etc.
- Import train schedule from Excel for faster data entry

### Results & Plots

- Graphical plots using Plot Manager
  - Rail energy consumption including maximum, peak & average rolling demand
  - Trip profiles - acceleration, speed, elevation, etc.
  - Substation power flows & voltages
  - Train power flows & voltages per route
  - Rail voltage, track potential
- Alerts based on EN 50163 & EN 50329 standards



### Advanced Distribution Management System

- Long-Term Load Forecasting *New*
- Automatically download weather data *New*
- Automatic incremental model updates
- Improved dispatcher training simulator
- Integrated restoration & isolation plans
- Historical, Library & Excel data sources

### SCADA System & Architecture

- MCC / BCC redundancy with disaster recovery
- Encryption & authentication security
- Self-healing strategies
- Integrated front-end processor with native communication drivers
- Web services communication
- Automatic historical data replication
- Unlimited signals or measurements
- Native IEC 60870 protocol *New*
- Native ICCP protocol *New*
- Interface to ADMS & OMS

### Visualization & Dashboards

- Common workstation & Web HMIs
- HMI objects library
- Alarms & Events displays
- Service Tags / Operator Notes integrated with advanced applications *New*

### Real-Time & Historical Reports *New*

- User-definable scheduled & on-demand reports
- Real-Time & historical data
- Customizable Alarms & Events reports
- Web-enabled reporting
- PDF & Excel formats

### Intelligent Load Shedding Dashboard *New*

- Thin-client HMIs
- Monitor spinning reserve, load to shed, load status
- Automatic & manual trigger controls
- Graphical load shedding event analyzer & viewer
- Hardware communication dashboard

### Load Preservation

- Steady-state & transient response
- Fast response time (10ms) with secured communication
- Priority optimization based on number of trips per time period

### Switching Order Management *New*

- Mobile interface
- Crew assignment & field confirmation of actions
- Link switching sequences to orders
- Scheduled & active order viewer
- Control center confirmation of order
- Estimated time to completion
- Classification & User Access Management including Area of Responsibility (AOR)

### Switching Sequence Management *New*

- Unbalanced system validation
- Transfer to Mobile Switching Order Management

### Alarm Management

- Prioritizes events via graphical & tabular views
- Integrated SMS & e-mail services *New*

### Generator Operations & Maintenance

- Track life operating time & cost
- Multiple maintenance levels notifications
- Alerts for due maintenance schedules

## Control & RTU Hardware - etap iCE™ *New*

#### Controllers

- Substation Automation
- Intelligent Load Shedding
- Generation Control
- Data Acquisition
- Secure & Scalable Controller

#### Remote Terminal Units

- Data Acquisition & Control
- Field/pole mount RTUs
- Integrated RTU & fault detection

#### Communication Protocols

- IEC 60870-5-104/101
- DNP 3
- Modbus
- IEC 61850
- MMS/GOOSE
- GPRS, xDSL, VSAT, Tetra





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**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:



Registered to ISO 9001:2015  
ISO 9001:2015    10 CFR 50 Appendix B    10 CFR Part 21    10 CFR Part 50.55    ANSI/ASME N45.2  
ASME NQA-1    CAN / CSA-Q396.1.2    ANSI / IEEE 730.1    ANSI N45.2.2

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