

etap[®]

DISTRIBUTION

Energy Management Solution for Power Systems

Design, Operate & Automate Smart Grids



The unified **electrical** digital twin platform

ETAP Solutions Drive Utility Objectives & Priorities

Distribution Network Analysis, Planning, Protection & Advanced Distribution Management System (ADMS), leveraging the Electrical Digital Twin.

ETAP Grid™ offers integrated distribution network analysis, system planning and operations solutions on a progressive geospatial platform for simulating, operating and optimizing the performance of Smart Grids.

ETAP's electrical Digital Twin serves as the active blueprint of the grid and is the foundation for unified engineering and a real-time platform that seamlessly integrates multiple applications to accelerate productivity, increase efficiency and enable digitization of power systems at every stage of the electrical life cycle.



Grid Compliance & Modernization



Safety & Efficiency



Risk Management, Resilience & Reliability

Key Benefits

- ✓ Common electrical digital twin model with a unified interface, synchronized from multiple data sources
- ✓ Modular, responsive components using the latest hardware & software technologies
- ✓ Eliminated file-based data transfer & minimized effort to synchronize multiple databases
- ✓ Reduced software maintenance cost by utilizing a single software

Fully Integrated, Unified Digital Twin Solution From Design to Operation

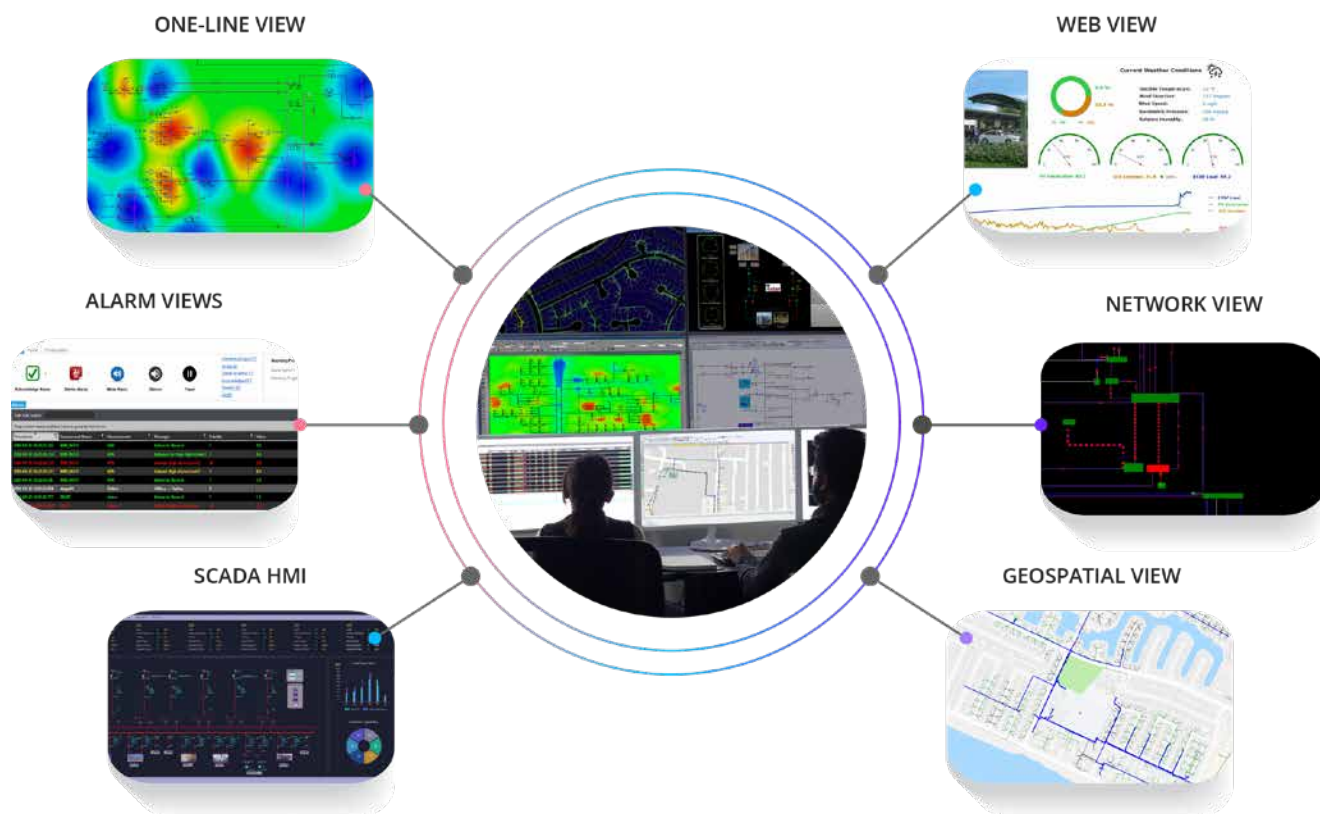


Digital Transformation for Energy Sustainability

Network Modeling & Visualization

An integrated logical and geospatial electrical digital twin foundation to model, configure, manage, and visualize electrical distribution networks.

Quickly and easily build 3-phase and 1-phase AC and DC network one-line diagrams and GIS views with unlimited buses and elements, including detailed instrumentation and grounding components.



Multi-Dimensional Digital Twin

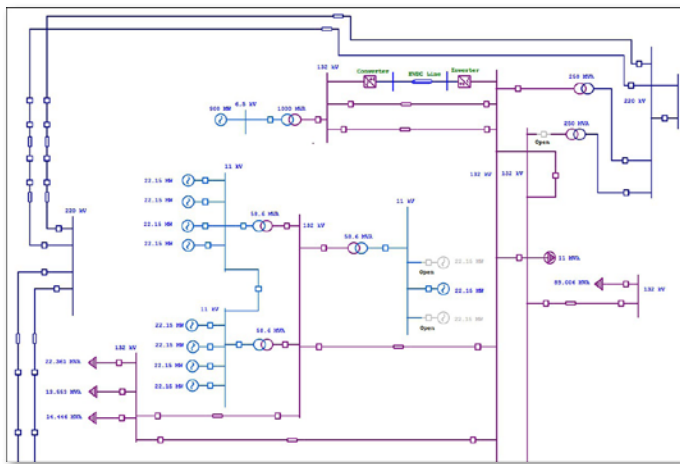
- Multi-dimensional planning using project wizards
- Rule-based data entry & modeling
- Scenario visualization & simulation
- Intelligent data exchange interfaces
- Server-client applications with user-access control
- Base & revision data layers with merge management
- etapPy™ – scripting & study automation using Python™

Geospatial View

- Intelligent electrical GIS view
- Distribution equipment modeling
- Intelligent circuit tracing & loop detection
- Incremental import from ESRI® & CIM

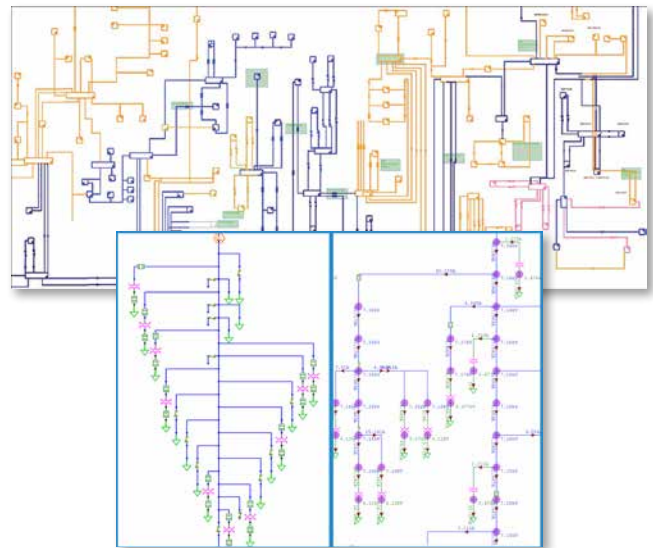
Intelligent One-line View

- One-line diagram & templates
- AutoBuild - automatic equipment connection mode
- Built-in intelligent graphics
- Network nesting
- Synchronized GIS & one-line views



Feeder, Substation & Network Diagram

- Synchronized electrical geospatial diagram, substation & equivalent circuit views
- Model 1,000s of components as an equivalent feeder
- Generate a logical feeder layout for individual or groups of feeders in single or multiple views
- Display simulation results on geospatial & feeder views



etapAppTM

Data Collection & Synchronization

View, create, edit and share ETAP one-line diagrams and engineering data across desktop and mobile devices - anytime, anywhere. Simplify your data verification and validation while you are out in the field and synchronize with ETAP directly over wireless communication.

Download for free from the App Stores.



Network Analysis

A powerful set of analytical tools allows for simulation, prediction, design and planning of system behavior utilizing an intelligent one-line diagram and the flexibility of a multi-dimensional database.

Unbalanced Load Flow

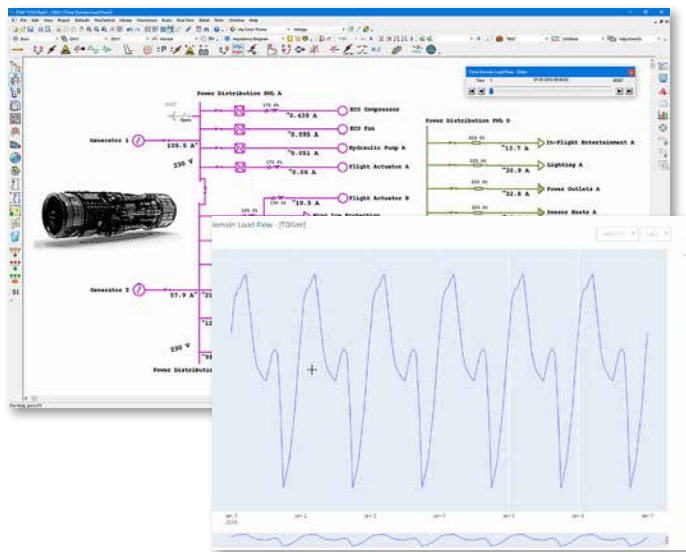
Calculate bus voltages, branch power factors, currents, and power flows throughout the electrical system.

- Consider swing, voltage-regulated, and unregulated power sources
- Connect multiple power grids and generators
- Perform analysis on both radial and loop systems

Time Domain Load Flow

Simulate varying load and generation in the system and solve the steady-state power flows over a function of time.

- Load growth planning
- Renewable energy assessment
- Consider unlimited loading and generation patterns
- Define seasonal variations including holiday adjustments



Unbalanced Short Circuit

Simulate unsymmetrical system faults for unbalanced networks.

- Unified AC & DC fault simulation
- 3-phase unbalanced and 1-phase networks
- Run and evaluate all fault types in one study
- Shunt, series, and simultaneous faults
- Fault current as a function of time with AC & DC decay
- Simulate protective device responses to fault currents and configuration changes



Reliability Assessment

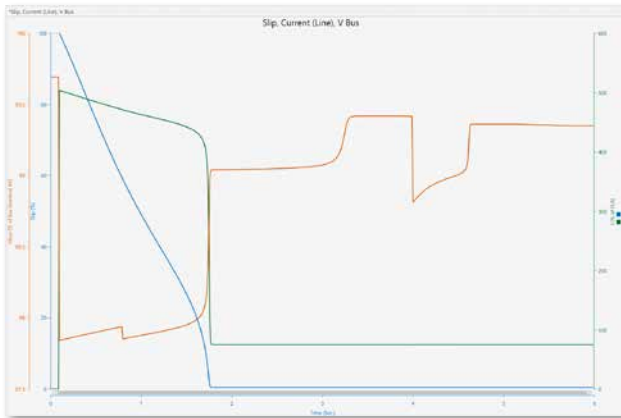
Assess availability and quality of power supply at each customer service entrance.

- Calculate reliability energy (cost) indices
- Calculate system reliability indices
- Calculate bus and load-point reliability indices
- Model reliability characteristics of each component
- Rank element contributions to energy (cost) indices

Load Allocation

Calculate unbalanced load allocation and non-technical loss.

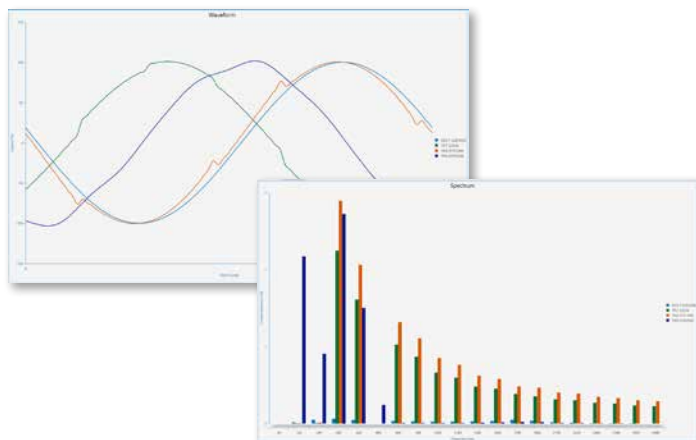
- Estimate individual loads on a feeder, based on load classes, load type, load curve, and load measurements
- Integrates with transmission state estimation to provide a unified and complete picture



Harmonics

Simulate harmonic current and voltage sources, identify harmonic problems, reduce nuisance trips, design and test filters, and report harmonic voltage and current distortion-limit violations.

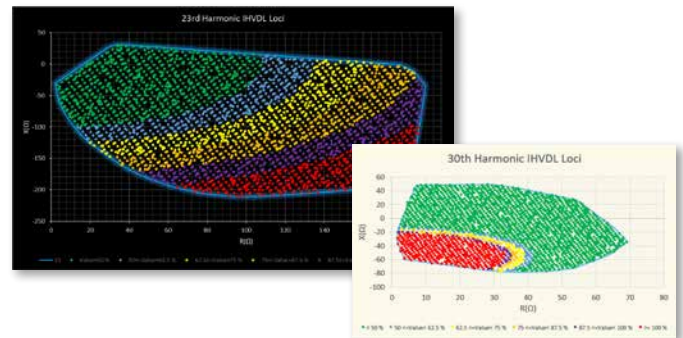
- User-expandable harmonic source library
- Model voltage & current harmonic sources
- Consider harmonic source magnitudes & phase angles
- Global, local & individual location compliance rule book for voltage & current distortion



Ground Grid Systems

Design and analyze ground protection, quickly and accurately.

- Flexible design methodologies for quick auto-designed layouts or highly detailed schemes
- Fast analysis of irregular large-scale renewable applications
- Color-coded graphical plots
- Automatically generate a two-layer soil model from soil measurement data



Cables & Lines

Design cable & line systems to operate to maximum potentials while providing secure and reliable operation.

- Calculate cable sizing, cable pulling tension, thermal analysis
- Perform line sag & tension calculations
- Analyze line impedance constants & ampacity

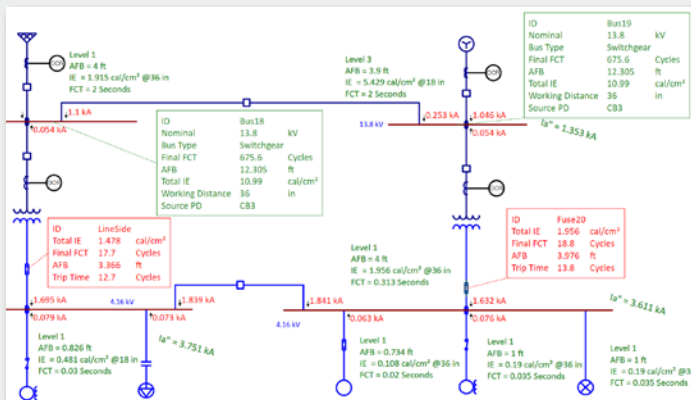


All-in-one software solution to perform AC and DC arc flash analysis on LV, MV, and HV systems.

- ✓ Calculate incident energy at multiple locations
- ✓ Worst-case arc flash scenario evaluation
- ✓ Arc flash labels, study data sheets & work permits
- ✓ Hazard evaluation for shock protection & PPE
- ✓ Integrated with Star-Auto Evaluation & TCC views
- ✓ Identify mis-operation due to arc flash

AC Arc Flash

Identify and analyze high-risk arc flash areas with great flexibility, by simulating and evaluating various mitigation methods and comply with IEEE1584-2018, DGVU-I 203-077, NFPA® 70E 2021, ENA NENS 09-2014 requirements.



DC Arc Flash

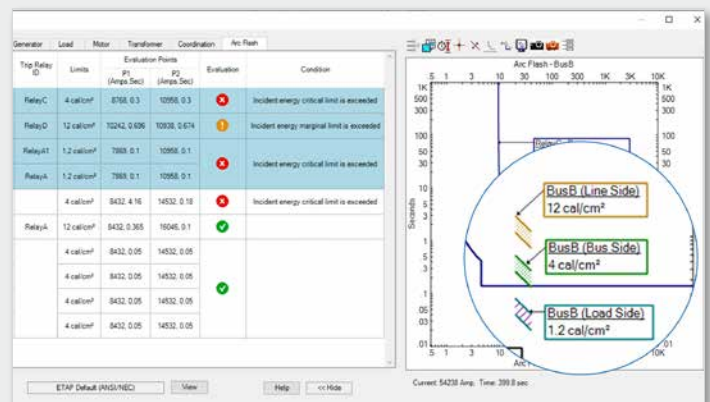
Calculate the incident energy for direct current applications: mission critical facilities, substation battery banks, photovoltaic plants, nuclear plants, and transportation systems.

Arc Flash Auto-Evaluation

Automatically assess, evaluate, and graphically report arc flash incident energy levels at different fault locations.

High Voltage Arc Flash

Evaluate arcing fault hazards for high voltage systems 15 kV and above, automatically determine the working distance and minimum approach distance based on the system voltage, transient overvoltage conditions, and altitude and comply with OSHA 1910.269 Appendix E and NESC-C2-2012 to 2017 requirements.



STAR - System Protection & Coordination

Analyze system protection and troubleshoot false trips, relay and breaker mis-operation, mis-coordination, and more.

- ✓ Time-Current Characteristic (TCC) Curve
- ✓ Protective Device Coordination & Selectivity
- ✓ Sequence-of-Operation
- ✓ Protection Zone Selection & Viewer
- ✓ Automated Protection & Coordination
- ✓ Zone Selective Interlock Scheme
- ✓ Protective Device Design Assessment
- ✓ Verified & Validated Protective Device Libraries

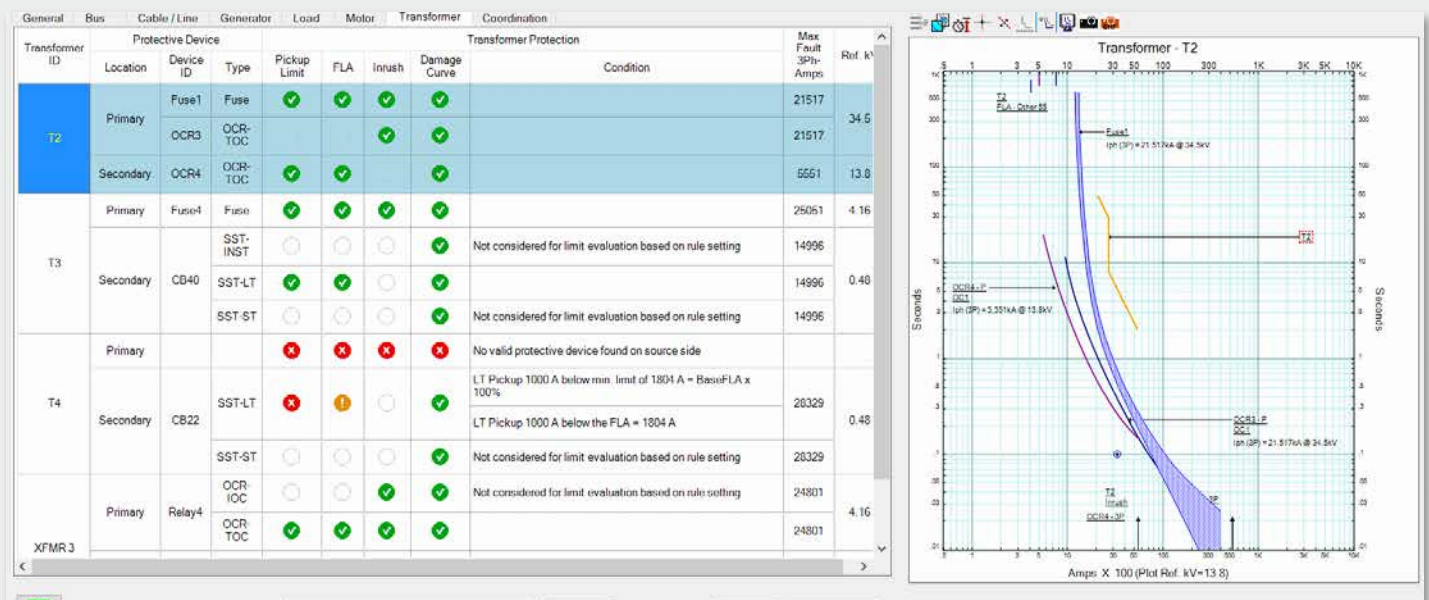
StarZ™ - T&D System Protection & Coordination

Gain insight into line protection, protective relay performance & evaluation, troubleshooting false trips, and system-wide protective device operation.

Star Auto - Automated Protection & Coordination

Rule-based design and automatic protection & coordination evaluation based on customized design criteria and industry guidelines to reduce months of work to a few hours.

- Automated & intelligent detection of protection zones
- Automated Overcurrent Protection & Coordination Evaluation
- Support of NEC, IEEE, IEC standards & industry practice rules
- Customized evaluation criteria based on Star RuleBook™

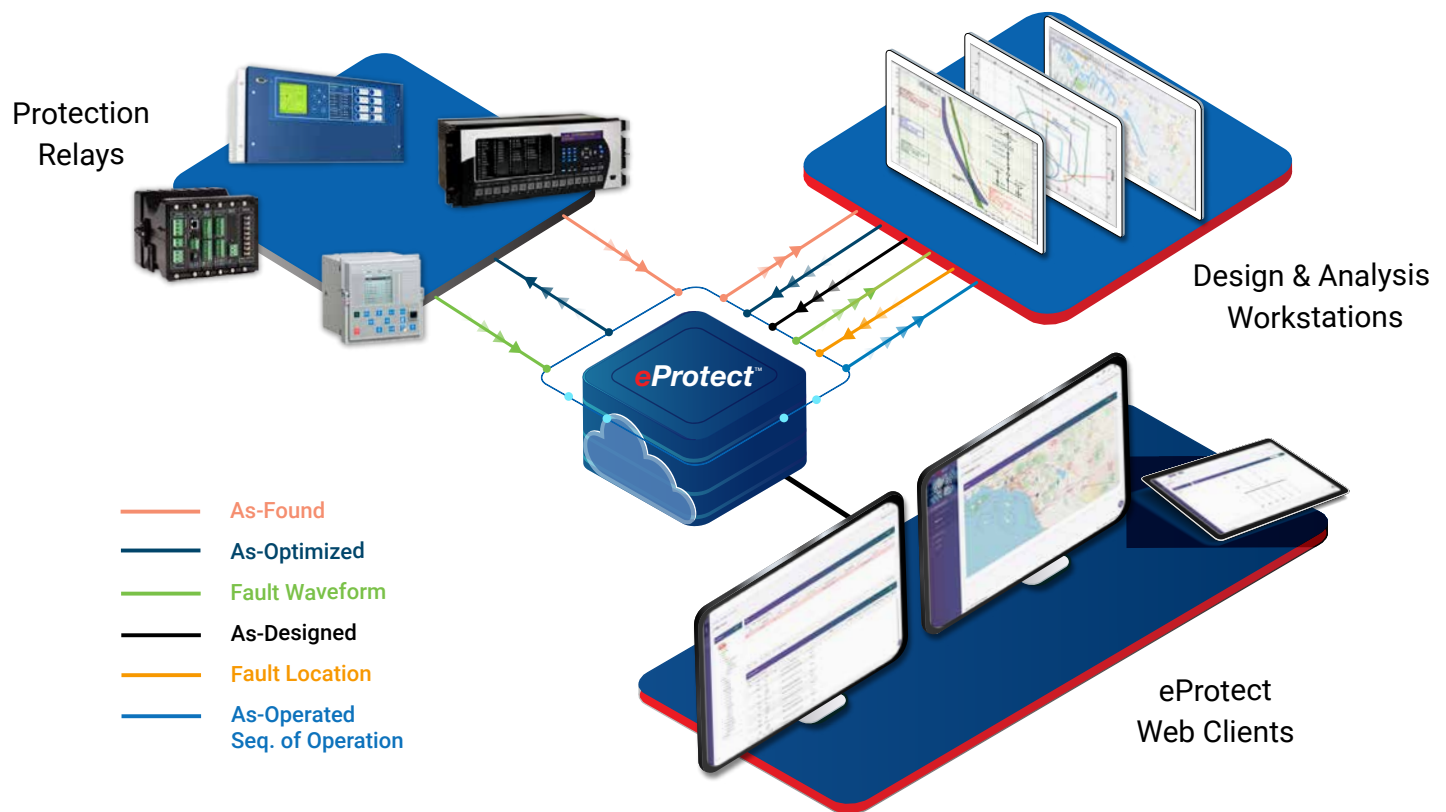


Boost productivity & save time with automated protection & selectivity

eProtect™ - Protection Asset Management System

Centralized protection asset management solution integrated with ETAP Protection & Coordination software to manage location, information and settings throughout the lifecycle of protective relays and substation assets.

- ✓ Increased data quality & access management
- ✓ Automatic processing & setting file generation
- ✓ Relay setting change management
- ✓ Protection system maintenance plan
- ✓ NERC compliance summary reporting
- ✓ Multi-user environment for relay management
- ✓ Relay settings tracking dashboard & notification
- ✓ Protection visualization & evaluation
- ✓ Health monitoring & maintenance
- ✓ Integrated with Advanced Fault Analysis System



Data Exchange & Synchronization

- Automatically import the PD settings
- Download settings via FTP/SFTP/IEC 61850
- Upload settings to devices remotely
- Interface with vendor-provided software
- Import manually collected setting files
- Web interface accessible via mobile devices
- Data collection via etapAPP

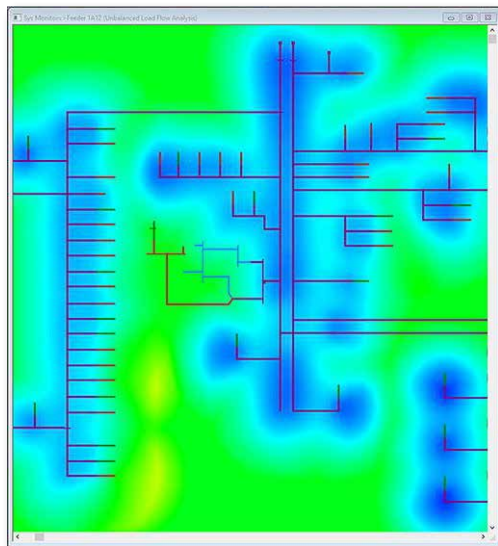
Relay Settings Change Management

- Compare As-Found to As-Designed settings
- Auditing of studies & implementations
- Automatic notification of settings changes
- Make data commonly available from all sites to users
- Flexible and secured architecture

Network Optimization

Volt/VAR Optimization (VVO)

Optimize system-wide voltage levels and reactive power flow for efficient distribution grid operation. Reduce system losses, peak demand or energy consumption using Conservation Voltage Reduction (CVR) techniques.



Optimal Capacitor Placement

Place capacitors for voltage support and power factor correction while minimizing installation and long-term operation costs.

Transformer Tap Optimization

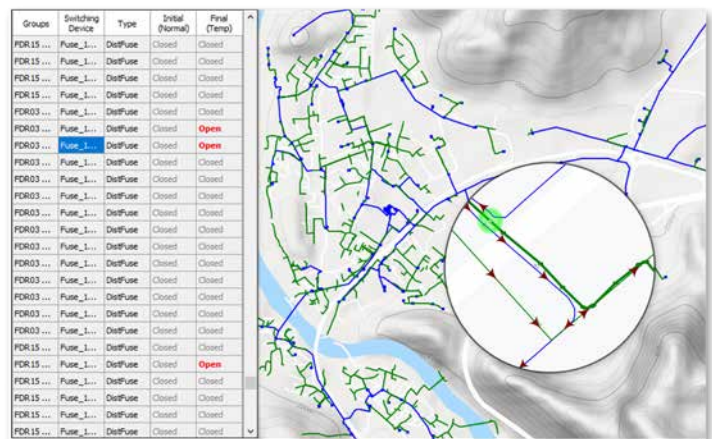
Determine the optimal turns ratio of a transformer to deliver maximum reactive power output.

Optimal Power Flow

Optimizes system operating conditions, and adjusts control variable settings, while ensuring system constraints are not violated.

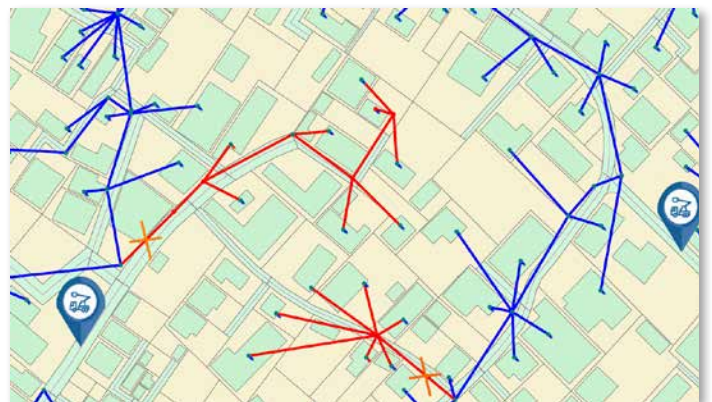
Switching Optimization

Optimize tie-point configuration based on multi-objective requirements to minimize system real losses and reduce or eliminate abnormal operating conditions.



Fault Management & Service Restoration

Determine optimal restoration strategies against forced outages to recover maximum number of affected customers.

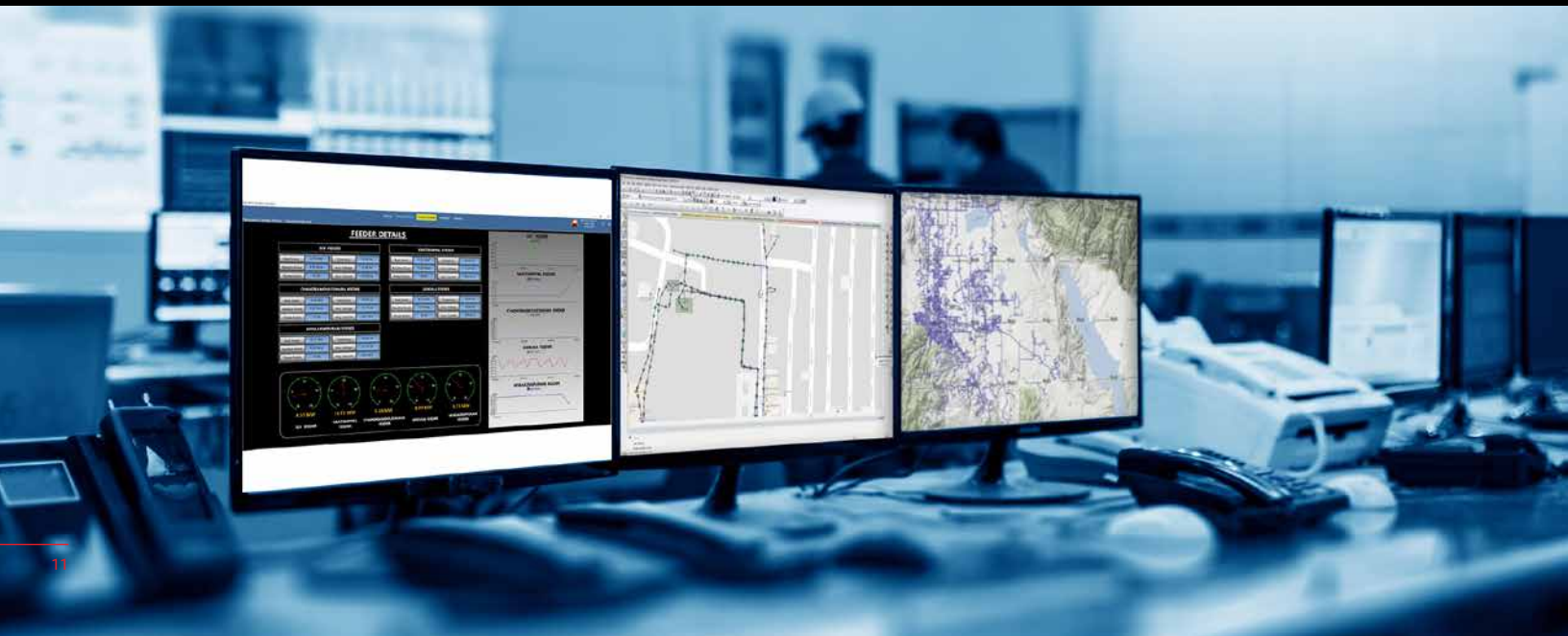


Advanced Distribution Management System

Model-Driven Planning, eSCADA, DMS & OMS Solution

ETAP ADMS offers an intelligent and robust decision-support platform based on a unified Digital Twin of the electrical network, with a collection of geospatial-based distribution network applications integrated with mission-critical operational solutions, to reliably and securely manage, control, visualize, and optimize small-to-vast distribution networks and smart grids.

- Integrated electrical asset information with network connectivity & visualization
- Predictive analysis for what-if & future conditions
- Advanced decision support analysis & adaptive optimization applications
- Improved system outage response time & reduced restoration cost
- Reduced downtimes & operational risks
- Improved system safety & security through real-world simulations
- Accelerated dispatcher operation training
- Command & control of substation assets
- Built-in cyber security
- Secure grid management developed on a secure-by-design platform
- Shared network management & visualization platform with extended field mobility
- Robust integration with any legacy protocols and OEM hardware
- Enabled implementation & integration with 3rd party platforms

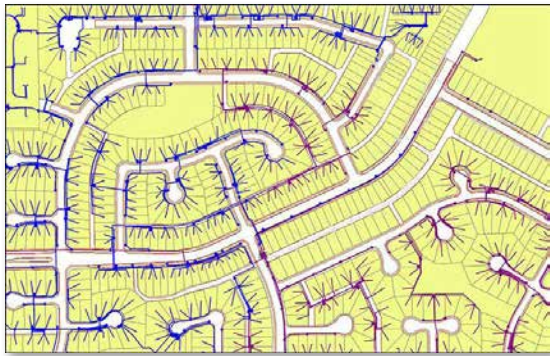


Distribution Management System

ETAP Distribution Management System (DMS) is an intelligent geospatial-based (GIS) distribution network solution that proactively reduces peak demand, optimizes network assets, while assisting distribution networks to deliver electricity more efficiently, reliably, securely, and economically.

Network Connectivity Analysis

Dynamically update electrical system topology such as branch impedances, loading, connectivity, breaker status etc., to calculate the real-time energization state; interface colorizes network maps based on various criteria.

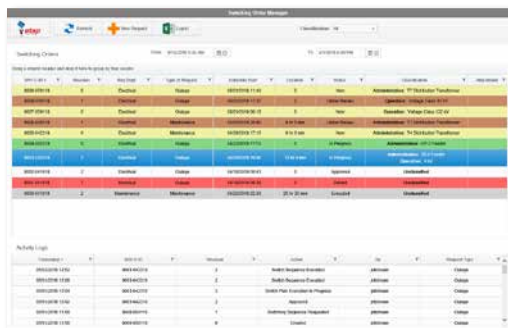


Load Allocation

Intuitive, intelligent, and integrated real-time monitoring of unbalanced distribution systems, including estimation of unobservable subsystems, and calculation of technical and non-technical losses.

Switching Order Management System

Enables power system dispatchers, operators and managers to request, assign, track, and log switching work orders.

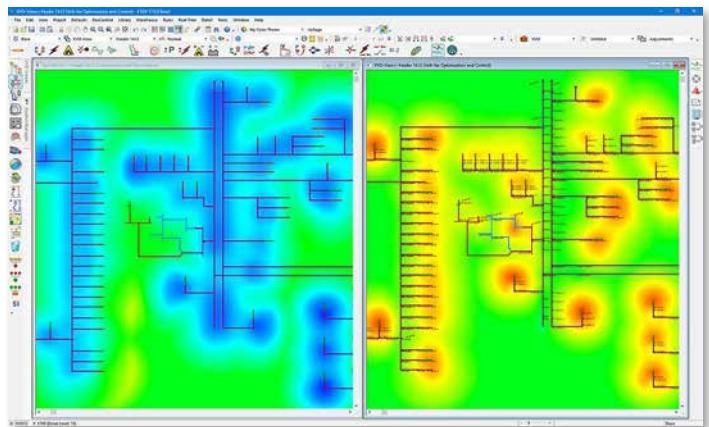


Feeder Balancing & Loss Minimization

Automatically determine the system configuration to provide optimal status of existing switching devices and suggest locations for new tie-open points to minimize system losses and reduce or eliminate abnormal operating conditions.

Volt/VAR Optimization & Control

Monitors real-time voltages, watts, and vars from LTCs, regulators, capacitors, voltage sensors, and customer meters to optimize and control the desired power factors and voltage targets.



Fault Isolation & Service Restoration

Identifies the section of the network to be isolated due to a forced outage and provides information on the affected customers. Determines optimal restoration strategy without reenergizing the fault and overloading the existing circuits.

Outage Management System - **OMS**

OMS assists in the restoration of power by predicting failures of isolation devices and providing information on outage extent and number of customers impacted; interfaces to third-party applications for Crew Management, Storm Management, and Estimated Restoration Time.

Planned Outage & Optimization

Load curtailment and optimization applications to schedule and execute planned outages to improve system reliability and switching strategies.



Storm Damage Assessment

Field crew records and reports the scope of network damage to operator via mobile devices in order to quickly evaluate, manage and mitigate.



Trouble Call Management

Records and summarizes outage-related customer trouble call information to analyze the location of any ticket and monitor the repair progress.

Outage Analysis

Automatically track outages, predict their most likely source and share information across your utility.



Outage Analytics & Reporting

Data acquired from monitoring devices is recorded and logged to provide a complete history of sequence-of-events (SOE) tracking and playback.

Crew Dispatch & Mobile Workforce Management

Enables quick creation of standardized and reusable templates, efficient system integration, and rapid deployment across the entire organization.

DER Management System - **DERMS**

ETAP enables engineers and operators to manage and mitigate the effects of renewable power sources under steady-state and dynamic conditions. Integrated with ETAP ADMS, the ETAP DERMS solution accounts for renewable energy resources along with energy storage to maximize the existing grid's distribution capability, while reducing costs to the customer.

- ✓ Analyze & operate green energy power systems
- ✓ Optimize DER performance
- ✓ Solar & microgrid capacity planning
- ✓ Ensure regulatory compliance
- ✓ Optimal charging, discharging and arbitrage
- ✓ Monitor DERs and identify operational margins
- ✓ Dispatch customer demand response devices
- ✓ Integrated with ETAP ADMS

Economic Optimization

Dispatch DERs based on cost optimization goals for grid services and energy arbitrage.

DER Controls

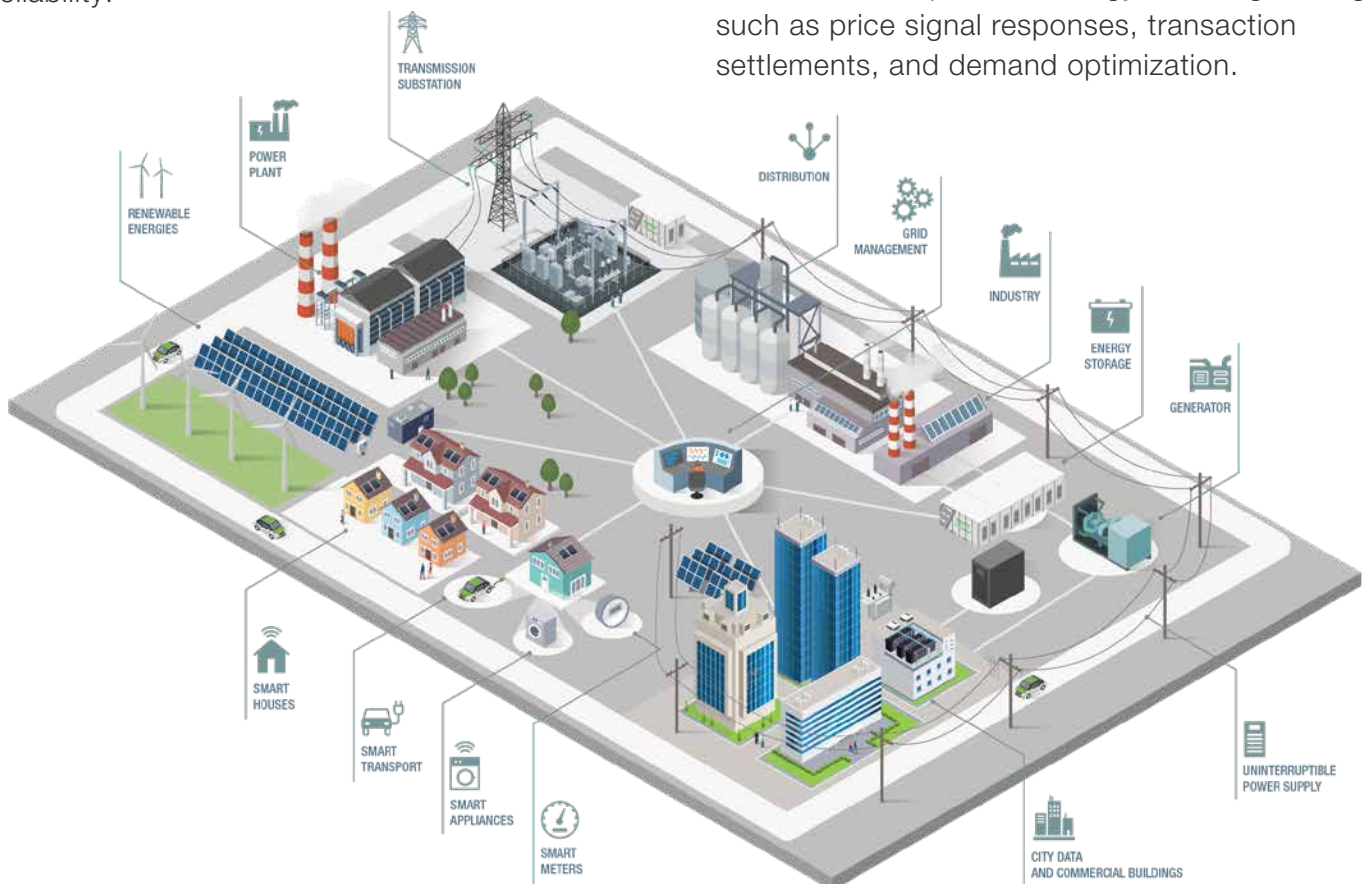
Enhance Situational Awareness under normal and abnormal switching conditions by deploying and interacting with participating DERs to increase reliability.

Energy Accounting & Settlement

Energy accounting provides energy usage analysis and cost allocation for individual units, areas, and the entire system. Track and create energy billing reports based on user-definable energy cost functions and energy tariffs.

Aggregate & Analyze Prosumers

Evaluate and implement energy-reducing strategies, such as price signal responses, transaction settlements, and demand optimization.



iDLS™ - Intelligent Distribution Load Shedding

iDLS offers an intelligent model-driven load curtailment system with optimization techniques to shed the minimum required distribution feeder loads based on reliability indices, quality of supply, and availability of distributed generation.

Optimized Reliability

iDLS utilizes each distribution customer's historical information, priority, and restoration time to determine the optimal combination of loads to shed. Load shedding combinations are selected such that customer satisfaction indices and reliability are not significantly impacted. Customer priority, number of previous outage incidents, and restoration times are considered in the optimal selection of feeders or loads to be curtailed.



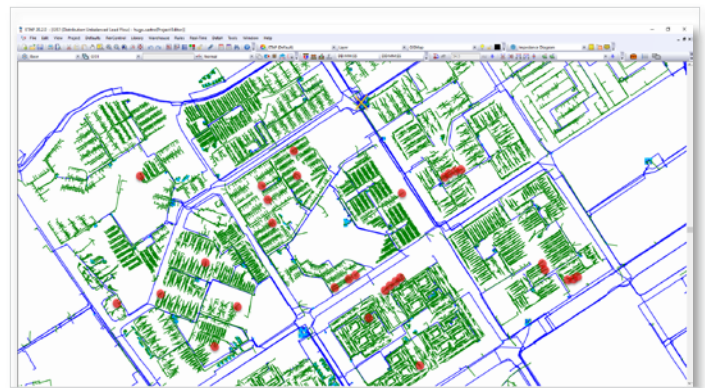
Load Curtailment Logging & Auditing

All load shedding events, reasons for curtailment, protection alarms, devices and customers affected are logged. Contingency and its effects are available in a chronological table, allowing planners and operators to assess and minimize load curtailment requirements to improve overall network reliability, quality of services, and security.

Load ID	Status	Reason	Device	Customer
1	1	APL1100001	APL1100001	APL1100001
2	2	APL1100002	APL1100002	APL1100002
3	3	APL1100003	APL1100003	APL1100003
4	4	APL1100004	APL1100004	APL1100004
5	5	APL1100005	APL1100005	APL1100005
6	6	APL1100006	APL1100006	APL1100006
7	7	APL1100007	APL1100007	APL1100007
8	8	APL1100008	APL1100008	APL1100008
9	9	APL1100009	APL1100009	APL1100009
10	10	APL1100010	APL1100010	APL1100010
11	11	APL1100011	APL1100011	APL1100011
12	12	APL1100012	APL1100012	APL1100012
13	13	APL1100013	APL1100013	APL1100013
14	14	APL1100014	APL1100014	APL1100014
15	15	APL1100015	APL1100015	APL1100015
16	16	APL1100016	APL1100016	APL1100016
17	17	APL1100017	APL1100017	APL1100017
18	18	APL1100018	APL1100018	APL1100018
19	19	APL1100019	APL1100019	APL1100019
20	20	APL1100020	APL1100020	APL1100020
21	21	APL1100021	APL1100021	APL1100021
22	22	APL1100022	APL1100022	APL1100022
23	23	APL1100023	APL1100023	APL1100023
24	24	APL1100024	APL1100024	APL1100024
25	25	APL1100025	APL1100025	APL1100025

Rotating Outages

iDLS can be configured to automatically or manually initiate a controlled load curtailment based on load priority blocks, classification, time-of-day, peak demand, and more.



Protection

iDLS evaluates and determines the capacity of all system components and operating constraints in order to protect the network under steady-state and dynamic conditions.

- Transformer overloads
- Under voltage
- Under frequency
- System overload
- Power transfer limits

iSUB™ - Substation Automation System

iSub intelligent Substation Automation System (SAS) provides protection, control, automation, monitoring, and communication applications as part of a comprehensive substation solution.

Switching Management

Switching Management allows the dispatcher to build, simulate, and verify a complete switching program using a fully-graphical user interface. The approved switching programs can be executed in one step, while maintaining compliance with safety and security procedures.

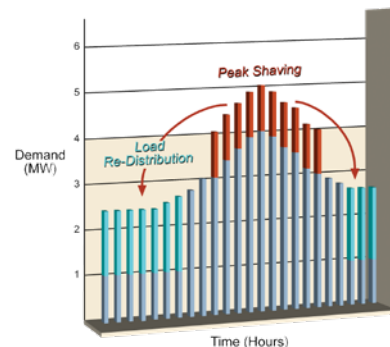
Substation Automation

Substation Automation utilizes intelligent analysis processes to dynamically manage, monitored data for substation levels and central system evaluation.

- | | |
|---------------------------|-----------------------------|
| Automatic voltage control | Load curtailment |
| Synchronism | Capacitor control algorithm |
| Tap position monitoring | Substation maintenance mode |
| Load & bus transfer | Fault detection |

Load Management

Load Management evaluates and implements energy-reducing strategies such as peak-load shifting, load-start inhibition, and shedding of non-critical loads to reduce energy cost.



eOTS™ - Operator Training Simulator

Improve and augment operator training through real-world experiential learning and evaluate contingency response to steady-state and dynamic scenarios for applications such as DMS, EMS, GMS, load shedding, and load demand controls.

- ✓ Accelerate operator & engineering training
- ✓ Virtual test of operator & controller actions
- ✓ Simulate & track the sequence-of-operation
- ✓ Ad hoc & pre-defined evaluation scenarios
- ✓ Avoid inadvertent outages caused by human error
- ✓ Improve & develop operator competency
- ✓ Trainer-to-Trainees learning environment
- ✓ Software-in-the-Loop system simulation

Operator Training Simulator

A model-driven power system training simulator mimics the sequence-of-operation scenarios using real-time data to perform and validate actions such as DER dispatch, load shedding, configuration switching, plant startup, and more.

Preventive Simulation

Preventive analytical modules provide automated alarms and warnings to the operator on possible events such as generator outages, contingencies, and suggest remedial actions.



etap SIL™ – Software-in-the-Loop technologies for dispatcher training & system commissioning



Thinking Power at Your Fingertips™



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