



ETAP Product Overview

Power System Enterprise Solution

ETAP is the most comprehensive analysis tool for the design, simulation, and operation of generation, transmission, distribution, and industrial power systems. From straightforward short circuit calculations to advanced transient stability studies, ETAP is the most flexible fully integrated solution available.

Engineers, operators, and managers in thousands of companies worldwide put their trust in ETAP; the only high-impact electrical engineering software to comply with widely accepted and firmly established nuclear quality assurance standards and regulations with complete Verification & Validation (V&V) of the analysis modules and library data. The V&V process for ETAP is quite extensive, consisting of thousands of test cases that encompass each and every calculation module, user interface, persistence, reports, plots, library data, and more.

ETAP modules are categorized or individually listed below. One or any combination of ETAP modules can be purchased or added to an existing ETAP license. The ETAP Base Package is required per each user license. Pricing is based on bus level, license type, and the number of copies.

Network Analysis

Load Flow
Short-Circuit – ANSI / IEEE
Short-Circuit – IEC
Arc Flash
Motor Acceleration

Distribution Systems

Load Flow - Unbalanced
Optimal Power Flow
Reliability Assessment
Optimal Capacitor Placement
GIS Map

Dynamics & Transients

Transient Stability
Generator Start-Up
Wind Turbine Generator
Parameter Estimation
User-Defined Dynamic Model

Protective Devices – Star

Device Coordination & Selectivity
Device Sequence-of-Operation
Relay Test-Set Interface

Transmission Line

Line Constants
Line Ampacity
Line Sag & Tension
HV DC Transmission Link

DC Systems

DC Load Flow
DC Short-Circuit
DC Battery Discharge & Sizing

Relay Test-Set

Advanced Relay Testing &
Transient Simulator – ARTTS

Transformer

Transformer MVA Sizing
Transformer Tap Optimization

Control Systems

DC Control System Diagram

Panel Systems

ANSI / NEC / IEC
1-Phase & 3-Phase Panels

Ground Grid Systems

Finite Element Method
IEEE 80 & 665 Method

Data Exchange

DataX - Base
DataX - MS Access & Excel
e-DPP® Interface
SmartPlant® Interface

Harmonics

Harmonic Load Flow
Frequency Scan
Filter Design & Sizing

Cable Systems

Underground Cable Raceway
Cable Ampacity Derating
Cable Sizing
Cable Pulling

Real-Time Systems

Power System Monitoring &
Simulation – PSMS
Energy Management System – EMS
Intelligent Load Shedding – ILS

ETAP Base Package

Network Simulation
System Elements
V&V Libraries
Multi-Dimensional Database

DataX – Base
Cable Sizing
Cable Ampacity Derating
Transmission Line Constants

Configuration Manager
Study Wizard
Report Manager
Power Calculator

Modules in ETAP Base Package

Network Simulation

- Intelligent graphical user interface
- Integrated AC, DC, & grounding systems
- 1-, 2-, & 3-Phase with 2-, 3-, or 4-Wire AC systems
- User interface for all network analysis modules
- Hide & show protective devices & grounding systems
- Theme manager with status dependent color control
- Propagation of nominal & rated kV, & phase connection
- Automatic display of energized & de-energized elements
- OLE objects, ActiveX controls, & hyperlinks
- Text box editor with dynamic link to properties
- Batch printing with view-dependent printer settings
- Customizable ETAP preference properties

System Elements

- Unlimited AC (1- & 3-Phase) & DC elements
- Unlimited buses: license dependent at run-time
- Nested composite networks & motor control centers
- Power grids, synchronous, & induction generators
- MOV, synchronous, & induction motors
- Exciters, governors, & stabilizers
- Voltage & frequency dependent lumped loads
- Cables, lines, reactors, & impedance branches
- 2W & 3W transformers with voltage regulators
- Remote connectors
- Harmonic filter & static var compensator
- Instrument transformers
- Protective devices & meters
- Single & double throw switches
- Batteries, DC motors, loads, & branches
- Chargers, inverters, UPS, & DC converters
- ANSI, IEC, or user-definable elements with rotation

V&V Libraries

- Comprehensive library: ANSI & IEC devices
- Validated & Verified (V&V) library data
- Cable, line, motor, harmonics, reliability, & battery
- CB, relay, fuse, & trip device
- V&V locked data
- Add, copy, merge, & delete capabilities
- User-defined & controlled libraries
- User-access control & security
- Edited-by & checked-by with date stamping
- User-controlled library merge

Multi-Dimensional Database

- Orthogonal multi-dimension database
 - Unlimited independent graphical views
 - Unlimited status configurations
 - Unlimited property revisions
 - Multiple loading & generation conditions
 - Real-time operating data
 - Unlimited study solutions
- ODBC – MS Access, SQL server, & Oracle®
- Dumpster with unlimited cells: copy & paste
- User access security with password protection
- Edited-by & checked-by with date stamping
- Merge project files via clipboard

Cable Sizing

- Size based on voltage drop, ampacity, & short-circuit
- Automatic cable selection from library
- Load based on LF result, rating, or user-defined value
- Load growth & application multiplying factors
- One-line & equipment cables
- Optimal or next alternative size options

Cable Ampacity Derating: A/G & U/G

- NEC - NFPA 70
 - U/G duct bank & direct buried
 - Cable tray, cable drop, & conduit in air
- ICEA P-54-440
 - Cable trays
 - Stolpe method
- Fire protection: wrap, stop, & coating

Transmission Line Constants

- Conductor & ground wire libraries
- Built-in configurations: horizontal, vertical, etc.
- General configuration: X, Y, & Z coordinates
- Multi-line mutual coupling
- Phase & sequence impedance matrix
- Transposed & un-transposed lines
- Short & long line models
- Operating temperature control
- Multiple layer soil model
- Calculated or user-defined impedances

DataX - Base

- Export WMF, EMF, DXF, & PDF files
- Import CSV, IEEE format, & RAW data files
- Import PowerPlot projects
- Import & export configurations
- Compress & e-mail project files
- Merge project files via clipboard

Configuration Manager

- Tabulate & control different status configurations
- Compare source, load & switching device status
- Flag changed data with checker capability
- Copy, merge, export, import, & print

Study Wizard

- Manage studies with scenarios & macros
- Record scenarios based on study settings
- Macro controlled scenario execution

Report Manager

- Customizable output reports & plots
- Input, results, alerts, & summary reports
- Reports via Crystal Reports® viewer
- PDF, MS Word, Access, & Excel reports
- Element ID & text search capability

Power Calculator

- MVA, MW, Mvar, kV, Amp, & PF conversion

ETAP Analysis Modules

Alphabetically Listed

Arc Flash

- IEEE 1584-2002, 1584a-2004, & NFPA 70E methods
- PPE compliance: NEC 110.6, OSHA 29, CFR 1910.132
- Embedded short circuit contribution calculation
- Embedded fault clearing time (FCT) calculation from TCC
- Automatic detection of primary & 2nd-zone protective devices
- Enclosed & open air configurations
- User-definable bolted fault current & clearing time
- User-definable categories for hazard risk PPE levels
- Customizable label templates & output reports

Cable Pulling

- Calculate & alert on forward & reverse pull tensions
- Calculate & alert sidewall pressures at bend points
- Check & alert NEC requirements
- Three-dimensional, multi-segment conduit layout
- Graphical isometric view with user-controlled perspective
- Pull multiple cables with different sizes
- Cradled or triangular cable configuration
- Allows any conduit slopes or bend angles
- Seamlessly integrated with ETAP network & UGS cables

DataX - Microsoft Access & Excel

- Import data from MS Access table
- Import data from MS Excel worksheets
- Customize data mapping via graphical user interface
- Data range checking with library data substitution
- Automatic one-line diagram generation
- Intelligent data validation & consistency checking
- Automatically add, modify, & delete elements
- View modifications & accept/reject actions

DC Battery Discharge & Sizing

- Battery discharge with load duty-cycles or time-span methods
- Battery sizing with battery & system deviations
- IEEE 308, 485, 946 Standards
- Battery temperature, aging, initial capacity, & design margins
- Plot & report battery duty cycle & discharge curves
- Battery library: extensive manufacturer data
- Integrate with AC/DC network & control system diagrams
- Discharge calculation via load flow or individual duty cycles

DC Control System Diagram

- Control system simulator: control (elementary) diagrams
- Sequence-of-operation with voltage drop calculation
- Control logic simulation with pickup & dropout voltages
- Start & stop push-button operations
- Burden & inrush rating or duty cycle calculation methods
- Integrated with battery discharge & sizing module
- Intelligent graphical user interface with drag & drop
- V&V control relay, solenoid, & contact libraries
- Device controlled form C, convertible, NO, & NC contacts
- User-defined macro-controlled contacts
- Alert pickup, dropout voltages, & overloading

DC Load Flow

- Integrated AC & DC systems
- Multi-voltage DC system with DC converters
- Charger, UPS, inverter auto-switching modes
- Multiple battery connections with auto-activation
- Calculate voltage drops & power losses
- Operating modes: float, equalize, or fixed firing angle
- Critical & marginal under- & over-voltage alert

DC Short-Circuit

- Integrated AC & DC systems
- Multi-voltage system with DC converters
- Constant voltage or current battery & charger models
- Calculate total & individual fault current contributions
- Option to consider battery internal & inter-rack impedances
- Calculate fault current rising time

Device Coordination & Selectivity - Star

- Time current characteristic (TCC) view with multiple axes
- Integrated with intelligent one-line diagram
- Graphically adjustable device settings
- Customizable TCC plot & display options
- Interchangeable phase & ground operating modes
- Embedded 3-Phase & LG short circuit analysis: min & max
- Embedded motor acceleration analysis
- Intelligent alert view & troubleshooting tool
- True-to-the-form modeling of protective devices
- Extensive device library (Verified & Validated)
- User-definable device models & curves
- Multi-function, multi-level relays with smart curve integration
- Transformer I^2t & inrush point/curve
- Cable, motor, & generator I^2t
- Time difference calculator
- Automatic current & voltage scaling
- Customizable protective device setting report
- Batch printing of TCC curves
- Relay test-set interface
- Display steady-state & transient relay response

Device Sequence-of-Operation - Star

- Protective device interlock actions
- Graphical fault insertion anywhere in the network
- Automatic calculation of fault current contributions
- Automatic calculation of device operating times
- Global view of post fault actions & associated operating times
- Graphical & tabular view of sequence-of-operation & events
- User-defined fault type: 3-Phase & Line-to-Ground
- Shifted & normalized TCC curves based on fault contributions

e-DPP Interface - DataX

- Electrical data processing
- Map e-DPP elements to ETAP
- Synchronize e-DPP projects with ETAP projects
- Customize data mapping via graphical user interface
- Data range checking with library data substitution
- Automatic one-line diagram generation
- Intelligent data validation & consistency checking
- Automatically add, modify, & delete elements
- View modifications & accept/reject actions

Energy Management System - EMS

- Real-time energy management system
- Intelligent steady-state optimization & control
- Automatic generation control
- Demand-side management
- Peak shaving & time-of-use load management
- User-defined logic & macros for system control
- Inhibitive & permissive controls
- Supervisory & advisory control modes

Generator Start-Up

- Dynamic simulation of generator starting: black start
- Connect loads at any desired operating frequency & voltage
- Unlimited events & actions: same as transient stability
- Frequency-dependent machine & network models
- Include start-up behaviors of exciter, governor, & stabilizer
- Determine optimal generator loading time & load sequencing

GIS Map

- Display unlimited GIS presentations (maps) in ETAP
- Display results on GIS maps: load flow & short circuit
- Synchronize GIS data to ETAP projects
- Auto-generate one-line diagrams from GIS data
- Database mapping via a graphical user interface
- Automatically modify or delete existing elements
- Data consistency checking during data synchronization
- View modifications & accept/reject actions
- Map GIS features to ETAP elements

Ground Grid Systems

- IEEE 80 & 665 methods
- Finite element method for irregular configurations
- Conductor & rod optimization
- Two-layer soil configuration with surface material
- Embedded short circuit analysis
- 3-D plots for step, touch, & absolute potentials
- Import DXF file: ground grids layout
- Alert step & touch potential violations

Harmonics

- Harmonic load flow
- Frequency scan
- Filter design & sizing
- IEEE 519 Standard
- Harmonic current & voltage source libraries
- Automatic distortion limit evaluation: THD & IHD
- Telephone influence factors tif & I*T product
- Alert harmonic distortion limit violations
- Alert resonance frequencies & locations
- Alert capacitor & filter overloading

HV DC Transmission Link

- Combined rectifier & inverter transformers
- Comprehensive built-in control schemes
- Rectifier controls - constant current & power
- Inverter controls - constant voltage & beta angle
- AC controls - current, voltage, & power modulations
- Automatic harmonic spectrum calculation

Intelligent Load Shedding - ILS

- Real-time optimal load preservation
- Minimize down time for critical loads
- Fast response to mechanical & electrical disturbances: ~40 ms
- Artificial & user-defined intelligence & logic
- Spinning reserve consideration with multi-subsystems
- Load ranking & shedding based on actual operating conditions
- Unlimited user-defined schedules for load priority
- Real-time testing & validation of recommended actions
- Minimize spinning reserve requirements with increased reliability

Line Ampacity

- IEEE 738-1993 Standard
- Environment consideration: elevation, latitude, etc.
- Weather consideration: wind & atmospheric conditions
- Conductor material & stranding properties
- Calculate conductor temperature for a given ampacity
- Calculate ampacity for a given conductor temperature

Line Sag & Tension

- Multiple suspension spans with unequal length
- Unequal tower height
- High conductor operating temperature: above 100° C
- Prediction with creep, load, & temperature
- Ice, wind, & elongation coefficient

Load Flow

- Power flow & voltage drop calculation
- Real & reactive power losses & PF
- Automatic temperature correction
- Transformer phase-shift & LTC
- Load demand & bus diversity factors
- Multiple loading & generation categories
- Graphical display of results including load terminal voltage
- Automatic device evaluation: voltage & loading alerts

Motor Acceleration

- Dynamic & static motor acceleration
- Unlimited events with individual & group sequence starting
- Start/stop induction & synch motors, MOVs, & static loads
- Change generator operating conditions during simulation
- Motor starting via transitioning of loading categories
- Reduced voltage starters: auto-transformer, resistor, etc.
- Switching capacitor: bus or terminal connected
- Rotor resistance, reactance, & DY connection
- Soft starters: current, voltage, & torque controlled
- Motor dynamic & characteristic models
- User-defined polynomial & point-by-point load models
- Auto-alert on fail start, starting motors, & bus voltages

Optimal Capacitor Placement

- Optimal capacitor size & location: loop & radial systems
- Voltage & power factor objectives & constraints
- Minimize cost of capacitor installation & operation
- Option to select candidate buses
- Option to limit capacitor bank size per voltage level
- Use individual source or global energy costs
- User-defined planning period & interest rate
- User-defined min, max, & average load profile
- Calculate capacity release, costs, & savings
- Evaluate capacitor installation for various system loading
- Capacitor control method

Optimal Power Flow

- Interior points with barrier functions optimization algorithm
- Large scale systems with equality & inequality constraints
- Minimize active & reactive power losses
- Minimize swing bus power
- Minimize control movements & adjustments
- Minimize generation fuel cost & exchange energy costs
- Maximize voltage & line flow security index
- Generator AVR & MW control
- Voltage regulator & shunt compensation control
- Bus voltage & branch flow constraints

Panel Systems

- Intelligent panel design & analysis
- 1-Phase (2W & 3W) & 3-Phase (3W & 4W)
- ANSI & IEC Standards
- NEC load factors
- Load flow with graphical per phase display
- Automatic updating of upstream panels
- Customizable Excel & Crystal Reports[®]
- Panel schedule with internal & external feeders & loads

Parameter Estimation

- Induction machine circuits model
- Sensitivity based parameter estimator
- Single-cage models with deep-bar effects
- Use readily available motor rating data as inputs
- Plot torque, current, power factor vs. slip

Power System Monitoring & Simulation - PSMS

- Real-time system for intelligent monitoring & control
- Seamless integration with system metering & SCADA
- Minimize metering hardware using state estimator
- Real-time simulation using actual operating conditions
- Predict system response: "what if" studies
- Operator assistance & training
- Bench marking system model via real-time data
- Client-server architecture with access security
- Remote device control with confirmation
- Replay archived data & simulate alternate actions
- Customizable trending & energy usage/cost reports
- OPC alert & notification: operators, managers, engineers, etc.

Reliability Assessment

- Single & double contingencies
- Reliability sensitivity analyses
- System, load point, bus, cost, & energy reliability indices: SAIFI, SAIDI, CAIDI, ASAI, ASUI, EENS, ECOST, AENS, IEAR
- Fault isolation & load restoration
- User-definable & IEEE component reliability data library
- Expandable interruption cost library
- Report & plot cost evaluation & sensitivity analysis results

Short-Circuit – ANSI / IEEE

- ANSI C37, IEEE 141, 242, 399, UL 489-9 Standards
- Generator circuit breaker: C37.14 Standard
- Device duty calculation with automatic device evaluation
- Total bus or maximum-through fault current options
- Unbalanced faults: L-G, L-L, & L-L-G
- ½ cycle, 1½-4 cycle, & 30 cycle faults
- Comprehensive device library
- Auto alert marginal & overstressed devices
- User-adjustable contact parting time for HV CB
- User-definable fault impedance & pre-fault voltage
- Separate R & X networks for X/R calculation
- Graphical & tabular alarms of overstressed devices

Short-Circuit – IEC

- IEC 56, 60282-1, 60781, 60909, 60947 Standards
- IEC 61363 Standard: transient fault analysis & plot
- Device duty calculation with automatic device evaluation
- Total bus or maximum-through fault current options
- Unbalanced faults: L-G, L-L, L-L-G
- Maximum & minimum fault currents
- Maximum, minimum, & user-definable c factors
- Method A, B, or C for peak current X/R calculation
- Ith calculation & rating check
- Breaking duty vs. delay time reporting
- Graphical & tabular alarms of overstressed devices
- Automatic detection of mesh & radial networks
- Evaluation of LV CB based on ultimate or service ratings
- Graphical & tabular alarms of overstressed devices

SmartPlant Interface - DataX

- Map SmartPlant electrical equipment to ETAP elements
- Synchronize SmartPlant projects with ETAP projects
- Customize data mapping via graphical user interface
- Data range checking with library data substitution
- Automatic one-line diagram generation
- Intelligent data validation & consistency checking
- Automatically add, modify, & delete elements
- View modifications & accept/reject actions

Transformer MVA Sizing

- ANSI & IEC standards
- Auto-calculate downstream operating & connected loads
- Growth & expansion factors
- Short circuit & BIL impedance consideration
- Altitude & ambient temperature factors
- Required & standard size options

Transformer Tap Optimization

- ANSI / IEEE C57.116 Standard
- Optimize unit transformer turns ratio or tap setting
- Considers system & generator voltage variations
- Considers generation station auxiliary load
- Include transformer primary & secondary cables
- Plot generator voltage vs. Mvar output capacity
- Plot capacity based on existing data or optimized solution

Transient Stability

- Short & long term dynamic simulation
- Unlimited events & simulation actions
- Simulate disturbances, switching actions, & control settings
- Simulate MOV, induction, & synchronous motor acceleration
- Simulate impact & ramp loading of motors & generations
- Print & plot various generator, motor, bus, & branch variables
- Active playback of sequence-of-actions: tabular & graphical
- Automatic relay action (27, 32, 50, 59, 67, 81)
- Automatic multi-stage load shedding via relay interlocks
- Variable simulation time step
- Multi-subsystems with individual reference machines
- Equivalent, transient, & subtransient synch machine models
- Single & double cage dynamic induction models
- Built-in & user-defined exciter, governor, & PSS models
- Shaft torsion & multi-mass modeling
- Frequency dependent dynamic induction machine models
- Frequency dependent machine & network models

Unbalanced Load Flow

- Per phase power flow calculation
- 3-Phase (3W & 4W), 2-Phase (2W & 3W), & 1-Phase
- Demand load & voltage drop calculation
- Real & reactive power losses & PF calculation
- Unbalanced loads, line impedance, & voltage generation
- Multiple loading & generation categories
- Transformer phase-shift & voltage regulation action
- Transmission line coupling
- Automatic temperature correction
- Automatic device evaluation: alert loading, voltage violations
- Alert positive, negative, & zero sequence unbalanced rates
- Phase & sequence voltage & current reporting

Underground Cable Raceway

- Neher-McGrath Method
- IEC 60287 Method
- Underground duct banks & direct buried cable raceways
- Multiple raceways & soil conditions
- Multiple external heat sources
- Irregular arrangements with integrated AC & DC cables
- Graphical user interface for layouts, raceways, & conduits
- Steady-state & transient temperature analysis
- Optimization of new or existing raceways
- Ampacity optimization: uniform or hottest temperature
- Cable sizing based on operating temperature & loading
- Cable loading: load flow results, user-defined value, or real-time data

User-Defined Dynamic Models

- Governors, exciters, & power system stabilizers (PSS)
- Create custom control block diagrams
- Library of control blocks & elementary functions
- Step response test for each model
- Run-time compile within Transient Stability
- Import/compile models built-in Simulink®

Wind Turbine Generator

- Wind turbine generator modeling: individually or in groups
- Dynamic turbine & controller models
- Generation based on wind speed & turbine characteristics
- Multiple wind speed categories for predictive "what if" studies
- User-defined turbine model or based on library
- User-defined wind model or based on library
- Individual or zone-based wind gust & ramping transients