

Arc Flash

Arcing Fault Currents
Fault Clearing Times
Incident Energy
NFPA 70E
IEEE 1584
CSA Z462



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

Intelligent

Load Shedding

Adaptive Load Shedding

Automatic Islanding

Dynamics

& Transients

Transient Stability

Generator Start-Up

Wind Turbine Generator

User-defined Dynamic Model

Parameter Estimation

Load Preservation & Management

System Restoration & Control

Load Shedding Validation

Star Protective Devices

Sequence-of-Operation Relay Test Set Interface

Protection Coordination & Selectivity

Monitoring

& Simulation

Real-Time Monitoring
State Estimation
Energy Accounting
Predictive Simulation
Event Playback
Load Forecasting

User-defined Dynamic

Modeling

Graphical Logic Editor
Transfer Function Blocks
Import/Export to Simulink®
Excitor/Governor/Stabalizer
Generic Load

Renewable Energy

Wind Turbine Generator Wind Farm Photovoltaic Array

DC Systems

Load Flow Short-Circuit Control System Diagram Battery Discharge Battery Sizing

Base Package

Cable Ampacity & Sizing
Transmission Line Constants
Report Manager
Project Management Wizards
Output Report Comparator
Multi-Dimensional Database
Libraries

Data Exchange

DataX
MS Access® & Excel®
CAD Interface
e-DPP® Interface
SmartPlant® Interface
Third-Party Software

Cable

SystemsCable Sizing - Phase

Cable Sizing - Grounding/PE Cable Ampacity Electric Shock Calculation

Underground Thermal Analysis

Cable Pulling

Transmission Line Line Constants

Distribution

Unbalanced Load Flow

Optimal Power Flow

Transformer Tap Optimization Switching Sequence Mgmt.

Arc Flash

DC Arc Flash Result Analyzer Sequence Viewer

Energy

Management

System
Automatic Generation Control
Economic Dispatch

Power

QualityHarmonic Load Flow
Frequency Scan
Harmonic Filters

Supervisory Control

Interchange Scheduling

Reserve Management

Reliability Assessment

Optimal Capacitor Placement

GIS View

Line Ampacity Mutual Coupling Sag & Tension HV DC Transmission Link

Ground Grid Systems

Finite Element Method IEEE 80 Method IEEE 665 Method

Network Analysis

Short Circuit – ANSI Short Circuit – IEC Load Flow Motor Acceleration

Panel Systems

ANSI Panel IEC Panel Code Factors Schedule Reports

Intelligent Substation

Substation Automation
Switching Management
Load Management
Smart Grid
Micro Grid

Arc Flash Analysis

Reduce Risk, Improve Safety, Enforce Compliance

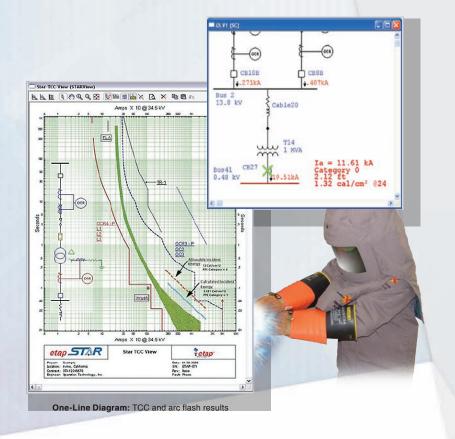
ETAP Automatically Calculates...



Arcing Fault Currents
Protective Device Operating Time
Arc Fault Duration & Decay
Incident Energy
Arc Flash Protection Boundary
High Incident Energy Areas

Industry Leader in Comprehensive Arc Flash Analysis Solutions

ETAP Arc Flash Analysis provides multiple capabilities for faster and easier performance. ETAP Arc Flash Analysis allows you to identify and analyze high risk arc flash areas in your electrical system, and it also allows simulation of several different methods used by engineers to mitigate high incident energy. This integrated program enables you to create multiple scenarios to determine which configuration produces the highest incident energy. In addition, it provides several methods to print professional quality reports and arc flash labels.



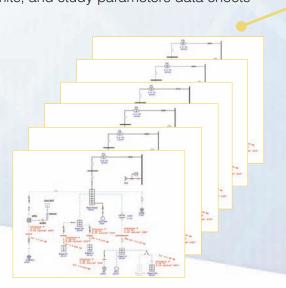


Arc Flash Result Analyzer

Arc Flash analysis requires the consideration of several scenarios including those which produce the maximum and minimum fault current levels. The task of analyzing the results from different scenarios is greatly simplified with the use of the Arc Flash Result Analyzer. With one click, this time-saving tool allows you to determine which scenario produces the worst case results. The analyzer also provides warnings and filters out problem areas which present problems in the Arc Flash analysis. Once the results are analyzed, labels and reports can be generated directly from the analyzer for all the faulted locations including arc faults at the buses, protective devices, or load terminals.

Features

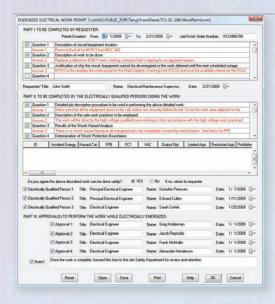
- Sort results from different studies by multiple criteria
- Find the worst-case incident energy results
- Quickly identify incorrect sequence of protective device operation
- Find which protective devices failed to operate
- Filter out & analyze results by incident energy levels
- Identify arcing current variation problems
- Identify slow operation of protective devices
- Automatically Export / Create MS Excel arc flash reports
- Analyze the results in metric or english units
- · Color code & filter results by incident energy level
- Group arc flash results by equipment location
- Generate standard / custom arc flash labels, work permits, and study parameters data sheets





Arc Flash Report Analyzer										•	
Output Report Scenario		ID ID	Voltage (Vol	n) Output Rpt.	Configuration	Total Energy	Hazard Category	FPS (H)	Final FCT	T	
Ref Select Recots	П	Bus1	0.48	AF-HallCycle	Nomal	5.7	Cat 2	5.7	10.5	T.	
	H :	But2	0.48	AF-HalfCycle	Nomal	0.9	Cat 0	1.7	3.6	Tr	
AF-HalfCucle	1 3	LVBut	0.48	AF HalfCycle	Nomal	8.3	Cat 3	4.9	12	П	
		Main Bus	34.5	AF-Decay	Normal	130.6	5 Cat 4	31.4	17.2		
AF-LVSymy AF-Madi		MCC1	0.48	AF-HalfCycle	Nomal	1.5	Cat 1	1.7	3	Ш	
□ AF-MeiF		Sub2A	13.8	AF HalfCycle	Nomal	22	Cat 1	5.6	13.2		
	1	Sub28	13.8	AF-HalfCycle	Nomai	35	Cal 1	9.1	14.7		
		Sub 3	4.16	AF-HalfCycle	Nomal	7.1	C#.2	18.6	13.9	ш	
	100	Sub3 Swgr	4.16	AF HalfCycle	Normal	6.5	Cat 2	17	13.9	\Box	
	= :	Sub22	3.45	AF-HalfCycle	Nomal	6.2	Cat 2	16.1	30.7		
Project Report		Sub23	3.45	AF-HalfCycle	Nomal	35.1	Cat 4	96.5	182.3	ш	
All Project in Active Directory		CB5.	34.5	AF-Decay	Normal	130.6	3 Dat 8	31.4	17.2	П	
Active Project		CB3	4.16	AF-HalfCycle	Nomal	6.5	Ca 2	17	13.9		
	_	C85	13.8	AF-HalfCycle	Normal	3.5	Cal 1	9.1	14.7	ш	
Example-ANSI		CBG	138	AF-HallCycle	Nomal	35	CH1	91	14.7	- 10	
V But		C87	0.48	AF-HalfCycle	Nomal	1.5	Cat 1	1.7	3	П	
		C89	4.16	AF HalfCycle	Normal	7.1	Cet 2	18.6	13.9	ш	
Protective Device		C810	34.5	AF-Decay	Nomal	130.6	1004	31.4	17.2	ш	
Load Terminals		CB11	13.8	AF-HalfCycle	Nomal	2.4	Cat 1	6.1	14.3	I	
info		CB12	13.8	AF HalfCycle	Nomal	22	Cat 1	5.6	13.2	ш	
Volkage (Volks)		C813	4.16	AF-HallCycle	Normal	6.5	C#2	17	13.9	ш	
Type		CB15	0.48	AF-HalfCycle	Nomal	1.5	Cat 1	1.7	3	Ш	
Connected But	5	CB16	0.48	AF-HalfCycle	Nomal	1.5	Cat 1	1.7	3	13	
But Gap			1				-			. 1	
X Factor		Copy By Sort 2	1 21								
Grounding	20		-	F. P		Display 0		Reporting			
Results Filter Results By				Filter Reports By Hazard Category Actual Actual					ustom		
▼ Total Energy (cal/cn²)	A	V Incident Energy		NFPA 70E 2009		(C) Differen	ces with Flet.		Label		
Energy 1 (cal/cn/)			⊕Mn				Skip If Same				
Energy 2 (cal/cnf)	1	FCT Not Determined			cal/cnf	_		1			
Energy 3 (cal/cnf)		Electrical Control of the Control of		☑ Cat 0 1.2 -		* DOT ING	FCT Unit		Work Permit Data Sheet		
PPE Description		% la Variation		☑ Car1 4		- rerora		c 0	-		
FF8		FCT by Secondary PD		C# 2 8		Cycles			6		
✓ Hazard Calegory					5	_	-	-	-		
Final FCT		Exceeds Max. FCT		V CNA A	ė e	-	Visit Territor				
Total (a (kA)		Effect of Main PD Isolo	tion on FCT	Show Colors Export. Find			Help: Close				

Work Permits, Data Sheets, Labels, ...



Work Permits

According to NFPA 70E 2012 guidelines, written permits (work permits) are required when working on energized electrical conductors or circuit parts that are not placed in an electrically safe work condition. ETAP Arc Flash provides work permits which include all the elements required by Article 130.2(B) of NFPA 70E. The benefits of printing work permits from the AF program are the automatic population of the incident energy results and shock hazard analysis approach boundaries. The work permits also have the following features:

- Customizable to fit different requirements
- Can be saved for all locations and stored with the ETAP project to be used at a later time
- Can be printed based on the worst case AF analysis results or based on whatever operating condition is used to perform the energized work.

Are Flash Study Data Sheet Project / System Data Project Title Example Date Project System Data Project Standard Project Title Example Defended System Frequency 60 Hz ETAP Revision System Frequency 60 Hz ETAP Revision Normal Contract System English Configuration Study Case ID ANSI Date Configuration Normal Cabrie Units Cabrie Units Callenia Output Report Loc cation Units California Output Report Loc cation Defended System Example Analysis Defended Librespile Anal Report Name Library File Defended Librespile Analysis Shock Hazard Conditions Yes Included Energy 1.5 callens* Reinfeield Approach Boundary 1.00 ft V-Rated Gloves Yes Included Energy 1.5 callens* Limited Approach Boundary 1.00 ft Conditions Flash Protection Boundary 1.70 ft Analysis None Protection Description Analysis Analysis Analysis Analysis Analysis Analysis Analysis Shock Hazard Analysis Analysis

Data Sheets

The data sheet is an enhanced version of the arc flash analysis report. It gives a detailed description of what selections (parameters) were made in the short circuit study case and how the bus results were obtained. This feature allows you to share with field engineers or electricians all the study assumptions and study case options which were used to determine the arc flash analysis results. This information is of high importance to provide additional information about the methodology to determine the incident energy.



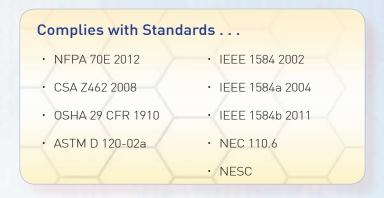
Multiple Language Arc Flash Labels

ETAP has a wide variety of professional quality arc flash labels in multiple languages including English, Spanish, French, and Portuguese. Automatically batch print arc flash labels based on highest incident energy from all operating modes.

Arc Flash Standards & Calculations

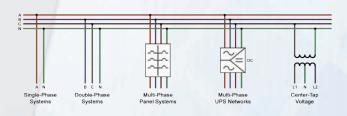
NFPA 70E 2009 Standard

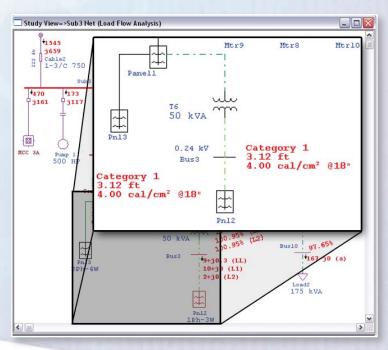
ETAP gives the option to define incident energy levels and personal protective equipment requirements based on NFPA 70E-2000, 2004, 2009 and 2012 standards.



Single Phase Arc Flash Calculations

In addition to 3-phase systems, ETAP arc flash allows you to perform arc flash calculations for 1-phase systems. This feature allows you to conservatively estimate the incident energy for single phase arc faults. The reality is that a lot of the equipment is single phase and engineers still need to determine what energy levels can be encountered at these locations. This tool allows the engineer to provide a conservative estimate of that energy.

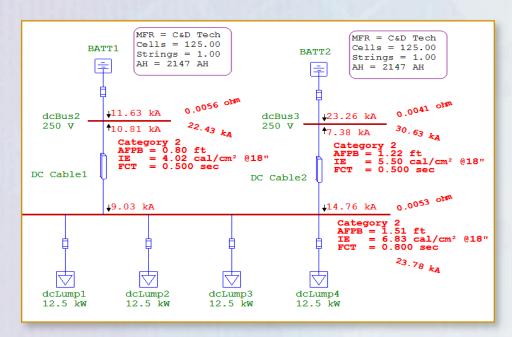




DC Arc Flash Features & Calculation Methods

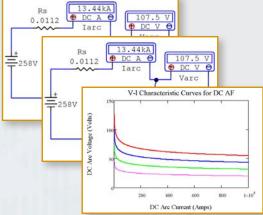
DC Arc Flash

The new NFPA 70E 2012 version includes one new annex section (Annex D.8) dedicated to the direct current incident energy calculation. The ETAP DC Short Circuit module has been integrated with three DC Arc Flash calculation methods. This allows the engineer to compare DC Arc Flash incident energy values and decide which method yields the most accurate results.



Calculation Methods

- Maximum Power
- Stokes & Oppenlander
- Paukert



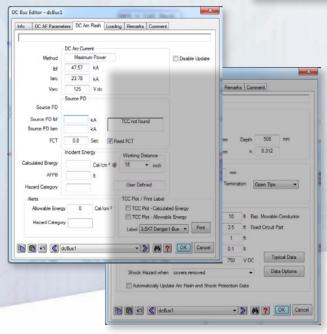
DC Arc Flash Analysis Features

- Arc Flash Result Analyzer
- Arc Flash Labels
- Incident Energy Plots

etap.com

- Display results on the DC One-Line Diagrams
- Export results to Microsoft Excel

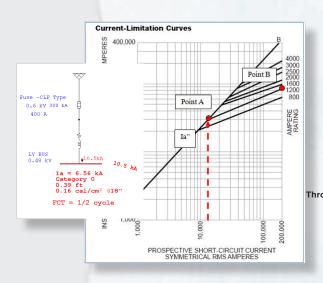


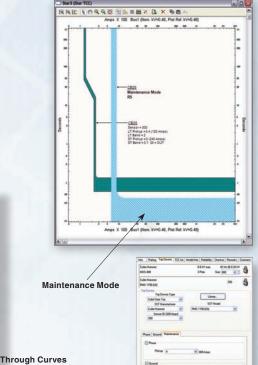


Simulate Incident Energy Mitigation Methods

Model the Incident Energy Reduction for

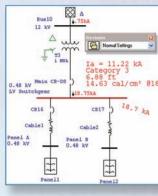
- Zone Selective Interlock Protection
- Maintenance Mode Switch
- Determine Current Limiting Fuse from
 - Peak-Let-Through Curve Method
 - IEEE 1584 Method
 - Bottom of the Curve Method
- Differential Relay Protection
- Light Detecting Relay Action

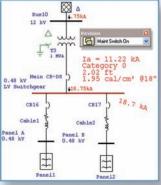


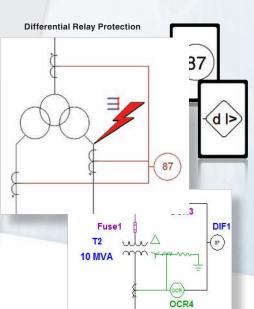


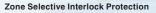


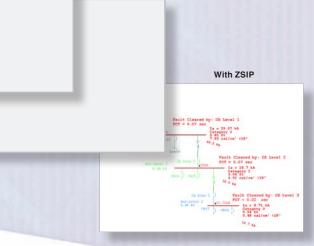
Without ZSIP



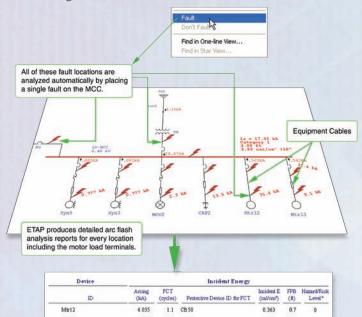








Most Capable & User-Friendly Arc Flash **Analysis Solution**



Mtr13 6.035 1.1 CB 53 0.363 # CB 35 9.6 Main CB 9.678 # CB 36 17.417 9.6 Main CB CB 50 17.417 9.6 Main CB 17.417 CB 53 9.6 Main CB 9.678

9.6 Main CB



One-Line Diagram to Reports to Labels: Calculate arc flash results at multiple

Simple Operation

- Run multiple arc flash simulations with one-click & analyze all the different results in seconds
- Define your own parameters or use systemcalculated results to determine the incident energy
- Use the Quick Incident Energy Calculator to analyze "what if" scenarios at every fault location

Automated Analysis

- Automatically determine the Arcing Fault Clearing Time
- Instant determination of the arc flash protection boundary
- Determine individual arcing current contributions
- Generate arc flash labels for every incoming main circuit breaker cubicle, load circuit breaker, & motor starter bucket
- Generate arc flash labels for every load terminal point including induction motors, synchronous motors, capacitor banks, & static loads

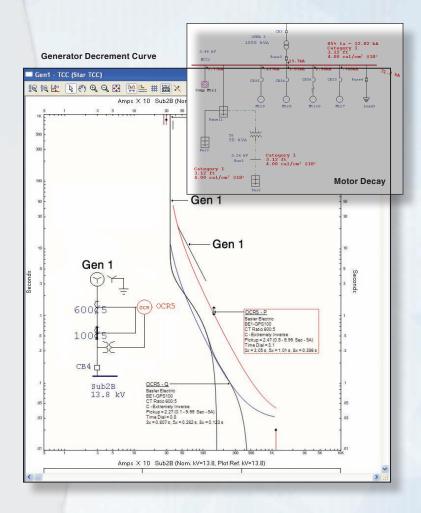
IEEE & NFPA Features

The following capabilities are available to comply with IEEE and NFPA guidelines:

- Limit the incident energy based on maximum fault clearing time (e.g., two seconds)
- Built-in empirical equation range limits alerts & grounding configurations
- Automatically distinguish between load & line side protective devices
- User-definable & typical IEEE Equipment Gap between conductors for buses & X-factors (based on IEEE 1584)
- Automatically handle Incident Energy calculation for low voltage buses (e.g., 208~240 volts or less)
- · Automatically assign incident energy for low voltage equipment



Comprehensive Arc Flash Analysis Options



Global Data Entry for Equipment

Speed up data entry for your arc flash projects by globally applying arc flash analysis data based on equipment type and voltage rating.

- Global definition of arc flash analysis data eliminates the need to specify this information in each bus
- Global definition of working distance, bus gaps, approach boundaries, & voltage-rated glove classes
- Specify Arc Flash Analysis Data based on IEEE 1584 or user-defined values
- Globally select Shock Hazard Analysis Data based on NFPA 70E 2000, 2004, 2009, 2012 or user-defined settings
- Globally change the glove class settings given by ASTM D 120-02a Standard
- Globally define the main protective device isolation settings (IEEE 1584b-2011)

Motor Contributions & Low Voltage Equipment Handling

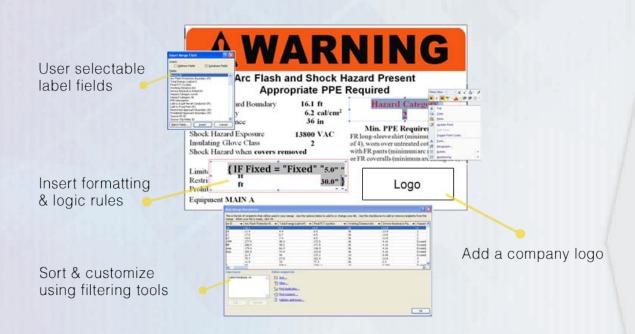
ETAP makes it easier to specify considerations that should be applied to low voltage equipment such as motors and transformers based on NFPA 70E & IEEE 1584.

- Consider motor fault current decay during the arc flash calculation
- Automatically exclude small motor contributions entirely from the simulation
- Automatically identify & exclude transformers with relatively low voltage & kVA
- Assign a hazard category to these types of equipments automatically based on fault current range

Comprehensive Arc Flash Safety Program

Custom Arc Flash Hazard Labels

ETAP allows you to create and customize arc flash safety labels.











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 21 10 CFR 50 Appendix B ANSI/ASME N45.2

ASME NQA-1 ANSI/IEEE 730.1

CAN/CSA-Q396.1.2 ANSI N45.22

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