Using CAPE Software for Computer-Aided Protection Engineering

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Summary

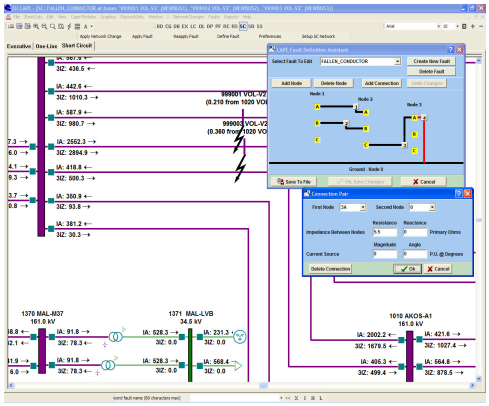
CAPE software gives power system engineers advanced tools for network and protection simulation.

Engineering students who gain experience with CAPE develop a thorough understanding of how the power system will respond under real-world fault conditions.

CAPE software is available for classroom and / or research use through the CAPE University Program.

CAPE for Fault Analysis

Simulate short circuits and see the protective device's response. Instantly compute any fault quantities for any type of fault, in any size network, without reduction. No restrictions due to mutual coupling. Studies can be automated and can include extensive real-world conditions.



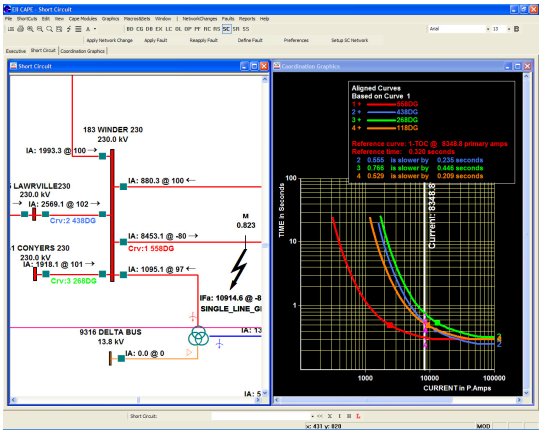
CAPE Short Circuit study conditions can include:

- ***Open and fallen conductors***
- ***Simultaneous faults***
- ***Faults among any number of buses and ground***
- ***Faults with impedances or known current injections***
- ***Faults between voltage levels***
- ***Fault location and impedance computed from measurements***

CAPE for Stepped-Event Analysis

Stepped event analysis calculates the protection system's time response to a fault, in order to easily find miscoordinations. A series of steady-state calculations simulates the sequence of protective device operations from the moment a fault occurs until the last breaker opens to clear it.

Miscoordinations can occur at any stage of the fault clearing process, so changes in voltage and current, and their impact on protective device operation must be accounted for, as various breakers operate and open.



CAPE can display the complex characteristics of all types of distance protection. Above, you can drag a fault to see instantly how coordination time intervals change.

CAPE for Whole Network Coordination Reviews

Coordination of protection reduces the risk of interruptions in service. CAPE's accuracy allows meaningful analysis of large amounts of data and automation makes large studies practical. It is not unusual to find that 25% of the lines studied require corrective action.

More information

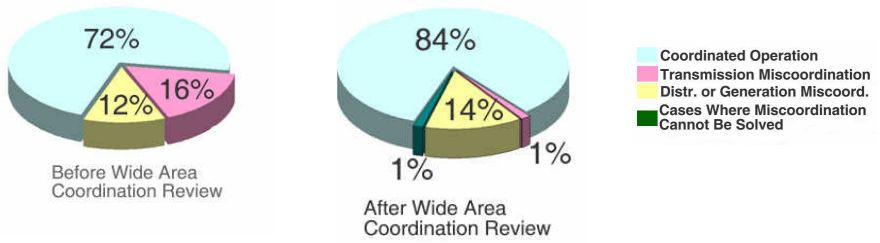
Protection Coordination in the Transmission System and Boundaries – a Wide Area Coordination Study

A Stepped-Event Technique for Simulating Protection System Responses

A Prediction of Relay Misoperation that Later Came True in the Actual Network

No.	Network Situation /Outages in Effect	Fault Type	Fault Location	Time(cyc)	Operation
1	Normal	SLG	Close-in :	F_21: 25 WALNUT S to 23 SO MAPLE	22.00 OK
2	Normal	SLG	Midline (15.0%):	F_21: 25 WALNUT S to 23 SO MAPLE	22.00 OK
3	Normal	SLG	Midline (50.0%):	F_21: 25 WALNUT S to 23 SO MAPLE	22.00 CTI VIOLATION(1)
4	Normal	SLG	Midline (85.0%):	F_21: 25 WALNUT S to 23 SO MAPLE	22.00 CTI VIOLATION(1)
5	Normal	SLG	Remote Close-in:	F_21: 25 WALNUT S to 23 SO MAPLE	22.00 MISCOORDINATION(1)
6	Normal	TPH	Close-in :	F_21: 25 WALNUT S to 23 SO MAPLE	22.00 CTI VIOLATION(1)
7	Normal	TPH	Midline (15.0%):	F_21: 25 WALNUT S to 23 SO MAPLE	22.00 CTI VIOLATION(1)
8	Normal	TPH	Midline (50.0%):	F_21: 25 WALNUT S to 23 SO MAPLE	22.00 CTI VIOLATION(1)
9	Normal	TPH	Midline (85.0%):	F_21: 25 WALNUT S to 23 SO MAPLE	22.00 MISCOORDINATION(1)
10	Normal	TPH	Remote Close-in:	F_21: 25 WALNUT S to 23 SO MAPLE	22.00 MISCOORDINATION(1)
11	Normal	LTL	Close-in :	F_21: 25 WALNUT S to 23 SO MAPLE	22.00 CTI VIOLATION(1)
12	Normal	LTL	Midline (15.0%):	F_21: 25 WALNUT S to 23 SO MAPLE	22.00 CTI VIOLATION(1)
13	Normal	LTL	Midline (50.0%):	F_21: 25 WALNUT S to 23 SO MAPLE	22.00 CTI VIOLATION(1)
14	Normal	LTL	Midline (85.0%):	F_21: 25 WALNUT S to 23 SO MAPLE	22.00 MISCOORDINATION(1)
15	Normal	LTL	Remote Close-in:	F_21: 25 WALNUT S to 23 SO MAPLE	22.00 MISCOORDINATION(1)

Automated Wide Area Coordination studies generate color-highlighted reports that show problems resulting from hundreds of faults. Before and after results of one utility's studies, below



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