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Protection

PSS®SINCAL

PSS®SINCAL offers a wide range of procedures for the complex field of protection in electrical transmission, distribution and industry networks.

PSS®SINCAL covers the calculation of protection settings, the coordination of devices and the documentation and simulation of events and different stages of protection security assessment. It supports the ANSI codes 27, 47, 49, 50, 51, 59, 67, 79, 81 and 87 including negative phase over- / underfrequency, over- / undervoltage and enhanced differential protection.

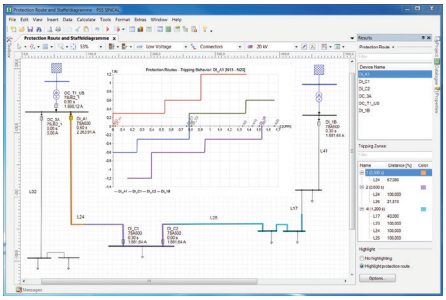

Figure 1: Reach zones for distance protection devices

Dimensioning of low-voltage networks (fuse assessment)

This module is a setting assessment of fuses in meshed and radial LV systems with short circuit sweep. The evaluations is based on:

- Safety factor (factor-rated current)
- Conductor cross section
- Thermal damage – short circuit
- Thermal load – Constant Current and large control current
- Maximum breaking time

It supports VDE 0102 and VDE 0100.

Settings calculation for distance protection

When PSS®SINCAL calculates grading values, it gives priority to the setting that causes the protection to respond selectively, regardless of how the network is connected.

Since there are different concepts or philosophies for setting protection devices, PSS®SINCAL offers several customizable options:

- DISTAL strategy
- Line impedance strategy
- Line impedance strategy connect
- Medium-voltage network strategy

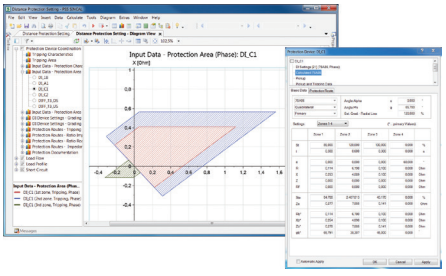

Figure 2: Calculated Settings for a 7SA86 device

Features are:

- Automatic calculation of settings for up to six zones plus auto-reclosure and tele-protection
- No network configuration limitations
- Detailed vendor-specific relay library
- Automatic evaluation of protection zones and worst-case configuration
- Multiple user-customizable setting strategies including one method that is selective for any network configuration
- Calculation of primary and secondary settings
- Diverse diagrams including X-t or Z-t

Overcurrent time protection

The PSS®SINCAL Protection Simulation module simulates the time sequence for fault clearance in networks, even in very complex, meshed networks. The locations of faults to be examined can be defined at nodes or any location on a power line or on cables. Single-phase, two-phase or three-phase faults as far as complex multiple faults, dynamic fault events and sequences can be simulated, arc impedances included. The engine behind the simulation is short-circuit or dynamic analysis.

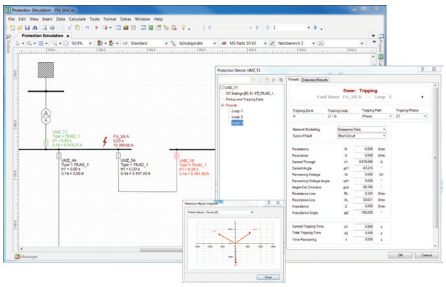

Figure 3: Stepped event analysis with results in map and masks

- Stepped event simulation, coordination and documentation of overcurrent time-protection in radial and meshed networks
- Interactive stepped event / sequence analysis including graphical display of coordination
- Simulation of main and backup protection
- Fault at nodes and branches including fault sweeps
- Signal transmission between relays for tripping, interlocking or transfer trip
- Protection library with several thousand relays
- Creation of user-defined protection devices based on predefined blocks, tripping curves can be defined by equations
- Coordination across different voltage levels
- User-defined diagrams can be created
- Protection settings can be adjusted in the diagram view
- Multi-axis diagram
- Time different calculator
- Cable and generator, motor (stator and rotor) and transformer damage curves
- Motor startup curves also with NEMA models including different voltage conditions
- Directional elements
- Common or individual tripping time behavior of tripping units/zones
- Stepped color coding of device states in the network diagram
- Display of all settings and states in the network diagram
- Reports for device settings and co-ordination checks

The documentation of full grading paths can be done automatically. It contains both input data and simulation data.

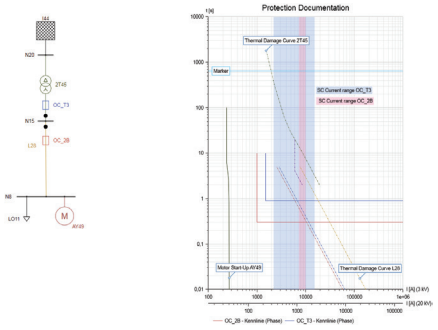

Figure 4: Documentation of a protection path including path in network and It-Diagram with result data

Enhanced protection simulation

Besides the normal protection simulation for industry network with overcurrent time protection, the program can also consider all types of protection devices that have been installed in the network at the same time. In addition it offers:

- Support of Distance, Differential, Ground Fault Differential, Voltage, and Frequency Protection
- Automatic simulation of protection routes with fault sweeps
- Set of result diagrams such as Z-t, Z-measured, Z-path (Z and X), R-X with line trajectories
- Color coded reach zone displays in the network diagram
- Fault locator

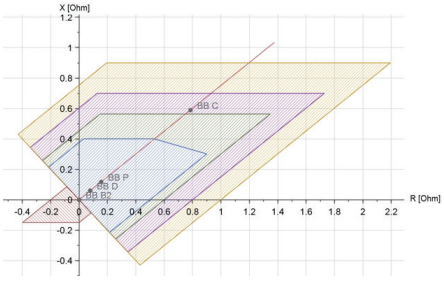

Figure 5: Impedance diagram including the line impedance (Shows the real reach of the device considering effects like intermediate infeed and parallel lines)

Protection security assessment

PSS®SINCAL offers different options based on the network and protection structure.

For radial distribution feeders with overcurrent time protection devices and definite time settings, PSS®SINCAL offers a tool to check the correct protection settings for I>, I>> and I>>> for current selectivity and time selectivity.

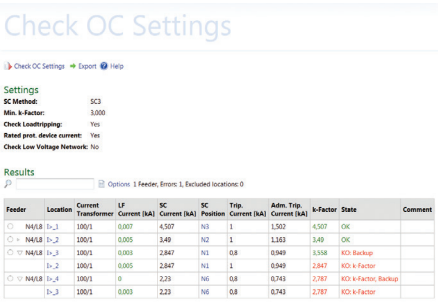

Figure 6: Automatic OC setting check for radial networks

In addition, the k-factor function can be used. The check the ratio between the minimal short circuit current and the in the relay set tripping current for main and backup protection (check of the reach zone and the pickup reliability). This check is also used during the hosting capacity analysis. Suitable protection settings are recommended.

The check of the correct setting of protection devices with regard to conductor cross-section, thermal damage, thermal load and maximum breaking time enables the design of protection systems in low-voltage networks.

For any kind of network, the PSS®SINCAL PSA module offers a full automatic validation of protection settings by systematical short circuit sweeps throughout the entire network (or network groups). The wizard which leads through the procedure allows:

- Fault type with user-defined fault impedances
- Main and backup protection assessment
- Backward protection, machine protection, specific transformer treatment
- Check of busbar protection
- Pickup and tripping sequences, tripping times, fault clearing times
- Dynamic Protection Simulation (RMS)
- Simultaneous calculation of different fault types (1-, 2-, 3- phase faults) and display of the Worst-case result from each calculation type in one result matrix
- User-defined maximum fault clearing time limits and line damage limit checks
- Interactive matrix based total assessment overview with color coding to identify critical settings
- In-depth evaluation of preselected events
- Color coding of results, also in the network diagram
- Enhanced reporting options including Word and List&Label documentation.

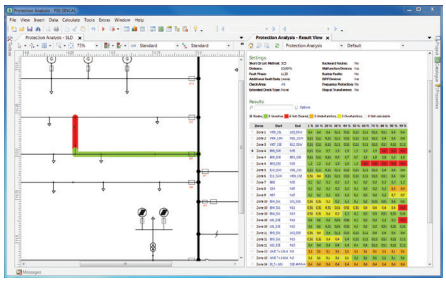

Figure 7: Assessment for primary and back-up protection for the complete network

Arc-flash

Linked to the evaluation of the protection devices is the simulation of arc-flash hazards. The focus is on the safety of personnel working close to the equipment.

- Arc-flash calculation in accordance with IEEE-1584, NFPA 70E-2012 and BGI/GUV-I 5188
- Support of empirical formulas for 208V to 15 kV, Lee method etc.
- Theoretical model for any voltage to cover any equipment
- User-defined protection devices
- Several options for incident energy calculation (meshed systems)
- Calculation of arcing-current energy
- Automated preparation of Arc-flash labels with flash protection boundary, Personal Protective Equipment (PPE) category and work permits

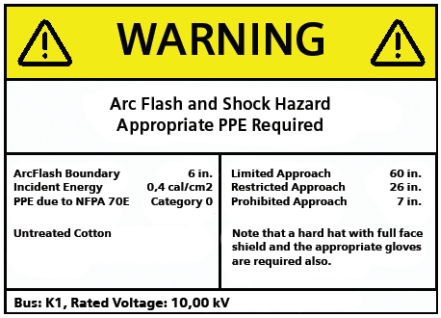

Figure 8: Arc Flash and Shock Hazard warning

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