Training Content

Protection

DAY 1

MODULE 1: Overcurrent protection

Presentation: Introduction to protection systems **1 h**

General introduction to protection terms, tasks and requirements with a focus on overcurrent protection. Ideal and detailed representation of instrument transformers. Modelling of relays and explanation of the relay type. Overcurrent plots with tripping and damage curves of different protection devices and equipment types.

Exercise: Defining protection devices and current transformers **½ h**

Implementing an overcurrent protection device graphically. Creating a time overcurrent plot and adjusting the settings.

Coffee break

MODULE 2: Overcurrent Protection in an Industrial Network

Exercise: Overcurrent protection in an industrial network **1 ½ h**

Modelling of overcurrent protection devices such as fuses, LVCBs, relays and calculation of setting values with regard to selectivity, taking into account thermal-mechanical damage curves of transformers and motor starting characteristics. Modelling of dedicated neutral current transformers and earth fault protection stages.

Q&A session

Lunch break

MODULE 3: Automatic Calculation of Overcurrent Settings

Presentation: Coordination Assistant for overcurrent protection **½ h**

Introduction to the Coordination Assistant for overcurrent devices. Concept and ideas on how to automatically calculate overcurrent settings.

Exercise: Automatic coordination of overcurrent devices **1 h**

Definition of user-specific coordination rules and time gradings. Application in an industrial network including coordination of LV and HV protection devices.

Coffee break

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MODULE 4: Directional Overcurrent Protection

Presentation: Directional overcurrent protection ½ h

Introduction of the directional overcurrent protection concept and presentation of the short-circuit trace feature.

Exercise: Modelling and testing directional overcurrent schemes 1 h

Modelling a directional relay and analysing the tripping with normal short circuit calculations and the short-circuit trace function. Plotting of relay current and voltage signals in a vector diagram.

Q&A session

DAY 2

MODULE 5: Distance Protection

Presentation: Introduction to distance protection 1 h

Functional principles of distance protection relays. Explanation of different starting methods to detect fault conditions and the impedance calculation. Presentation of the available distance protection plots R-X, time-distance and relay operational limits.

Exercise: Distance protection in a transmission network ½ h

Modelling a distance protection device with its instrument transformers. Calculate zone settings according to given equations. Testing different starting methods. Impact of the earth return impedance on the measured impedance using the time-distance plot. Usage of the relay operational limits plot.

Coffee break

Exercise: Distance protection in a transmission network (continued) 1 h

MODULE 6: Application of the Protection Graphic Assistant

Presentation: Protection Graphic Assistant ½ h

Learn how to use the Protection Graphic Assistant and its options: the reach colouring and the short-circuit sweep plots.

Q&A session

Lunch break

Exercise: Reach colouring and short-circuit sweep plots 1 h

Review of zone settings for distance protection zones using reach colouring. Effect of generator infeed and parallel lines on distance protection. Calculating short-circuit sweeps along a defined protection path and analysing the results in short-circuit sweep and time-distance plots.

MODULE 7: Automatic Coordination of Distance Protection Devices

Presentation: Coordination Assistant for distance protection **½ h**

Introduction to the Coordination Assistant for distance devices. Concept and ideas on how to automatically calculate distance reach settings.

Coffee break

Exercise: Calculation and verification of new settings **1 ½ h**

Definition of flexible setting rules and verification of two sets of settings. Result analysis using table reports and time-distance plots. Settings calculation in reverse direction and consideration of overcurrent devices for time grading.

Q&A session

DAY 3

MODULE 8: Differential Protection

Presentation: Introduction to differential protection **½ h**

Introduction to differential protection. Presentation of operation principle, differential characteristics, current transformer saturation and harmonic blocking.

Exercise: Modelling differential protection devices **1 h**

Modelling of transformer differential protection. Analysis of CT adapter block settings. Modelling of line differential protection. Testing the protection scheme using current comparison plots. Verification of secondary currents using vector diagrams.

Coffee break

MODULE 9: Automatic Verification of Protection Settings

Presentation: Protection Audit **1 h**

Principle of the Protection Audit tool. Determination of the protection category with a topological search. Verification of tripping times, fault clearing times and device coordination. Coloured table reports to analyse the results.

Exercise: Protection evaluation in different networks **½ h**

Application of the protection audit in two training networks with different philosophies and protection devices: Industrial and Transmission grid. Definition of fault cases and analysis of tripping times and coordination margins in small network areas. Expanding the analysis to the complete network with up to 70 protection devices.

Q&A session

Lunch break

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Exercise: Protection evaluation in different networks (continued) **1 h**

MODULE 10: Communication among Multiple Relays

Presentation: Relay communication **½ h**

Presentation of different communication schemes for distance and overcurrent devices.

Coffee break

Exercise: Modelling a reverse interlocking scheme **1 ½ h**

Modelling a reverse interlocking scheme. Adjusting existing relays and creating a new communication relay. Implementing the scheme in the network model and testing the functionality.

Q&A session

Time Schedule (Central European Time)

	Time
First 90 minutes block	9:00
Coffee break	10:30
Second 90 minutes block	10:45
Q&A session	12:15
Lunch break	12:30
Third 90 minutes block	13:30
Coffee break	15:00
Fourth 90 minutes block	15:15
Q&A session	16:45
End of the training day	17:00

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