# Overcurrent Protection – Selectivity Analysis

Overcurrent Protection module is used for the co-ordination of various protection devices in a given network and ensure the safety of the system. It allows the user to design proper protection scheme that can guarantee fast, selective and reliable relay operation to isolate the faulty section of the power system. The main objective of relay co-ordination is to achieve the desired selectivity without losing the sensitivity and quick fault clearing time. NEPLAN allows the user to perform relay co-ordination with an intuitive selectivity diagram tool.

## Necessity of Relay Co-ordination

- To make sure that the system operates safely and functions correctly by avoiding nuisance tripping of protection devices
- To determine the characteristics, ratings, and settings of protection devices which will ensure that minimum healthy part of the network is interrupted when protection devices isolate a fault
- Relay co-ordination is required when:
    - Planning of a new system to select proper protection device
    - Planning an existing system whenever there is a change in the network operating or topology conditions
    - When an existing equipment is replaced with a higher rated equipment
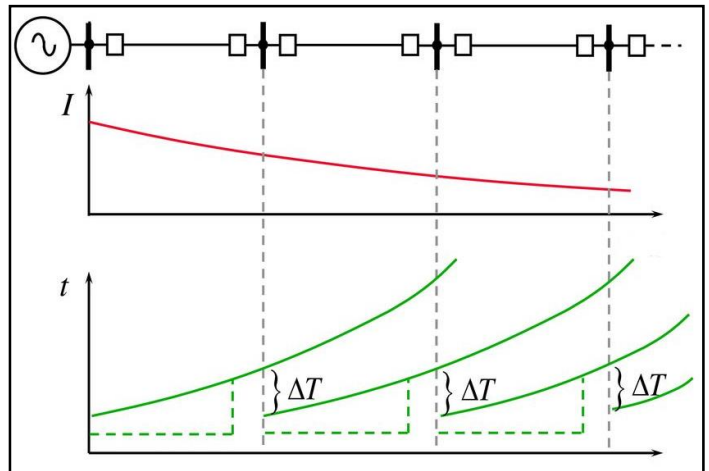


- Relay coordination principle for overcurrent protection devices
    - Overcurrent Relay
    - LV/MV Circuit breaker
    - Fuse & Miniature circuit breaker

## Relay Co-ordination with NEPLAN

- The response of the overcurrent protection devices is visualized in the time-current characteristics (TCC) curve
- These TCC curves can be viewed on the selectivity diagram using which the user can adjust the settings of devices that protect the cable, transformer, etc.
- Using protection assessment, the selectivity of the protection devices can be verified for the whole network by simulating all kinds of faults with various operational states simultaneously
- Sequence of operation for the protection devices can be visualized on single-line diagram for a fault at particular location
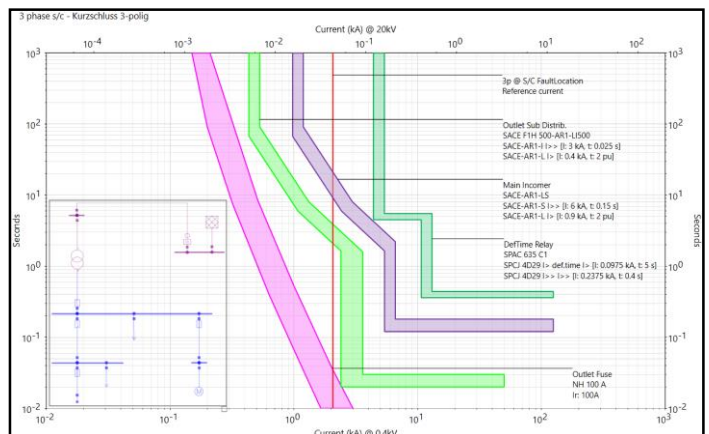


- Relay co-ordination using selectivity diagram in NEPLAN

# Protection Functions

- Several protective functions can be assigned to each protective device:
    - Overload
    - Directional/Bi-directional Overcurrent
    - Directional/Bi-directional Earth fault
    - Recloser
- All types of protective devices with a time-current characteristic can be entered: fuses, circuit breakers, definite-time and inverse-time over-current relays, electronic relays
- Exact modelling of current and time setting ranges
- Option to enter the tolerance for current and time values
- Characteristic can be shifted with a user-defined factor
- A total of 3 parameters sets can be saved for an overcurrent relay
- Visualization of the fault current seen the protection device and the corresponding tripping time
- Entry options for characteristics: user-friendly table & graphical editor for entering the characteristic point by point or by using a formula in conformity with IEC or IEEE/ANSI

# Selectivity Diagram

- Protection device and current transformers are positioned in the network plan graphically
- Single-line diagram view in the selectivity diagram
- Automatic generation of selectivity diagrams based on s/c calculation
- Unrestricted number of characteristics can be incorporated in one diagram
- Changing the relay settings directly in the selectivity diagram by moving the curves with mouse or with the help of navigation arrows
- Unrestricted number of diagrams can be processed simultaneously
- Selectivity analysis over multiple voltage levels and independently of the network type and size involved
- Two reference voltages for diagrams can be defined by the user
- Individualized coloring of the characteristics
- No limit on number of diagrams and protective numbers for management
- Export complete diagram to PDF, Word, PNG etc.
- Charts printing from the selectivity diagram
- Editing of axis settings and fonts for the labels
- s/c calculation directly in the selectivity diagrams
- Measurement tools to calculate the difference (current or time) between two curves

# Protected Elements

- i/t characteristics for protected objects are plotted automatically:
    - Motor start-up curve (from motor starting results or at 100% or 80% of the voltage)
    - Motor hot and cold start stall point
    - Stator thermal limit curve
    - Transformer damage curve and Inrush current
    - Thermal capability curves for lines/cables
    - Synchronous machine damage curve
- User has the option to plot the rated current of the equipment automatically on the selectivity diagram
- Characteristic can be shifted with a user-defined factor

# Protection Library

- NEPLAN offers an extensive library (around 4000 different types from various manufacturers) of the most widely used relays, circuit breakers and fuses
- The libraries are constantly updated and extended
- Possibility to import all the protection devices with a user-friendly template into NEPLAN
- Libraries handed out for free at the moment of NEPLAN software purchase or the update library can be downloaded anytime by the users with a valid maintenance contract from NEPLAN Support Area.