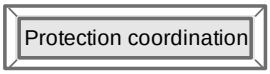
Protection: Protection coordination



Henry Gras, Jean Mahseredjian, 2018-06-21 11:33:00 AM

1 Introduction

The Protection coordination device is used to quickly calculate the tripping times associated with the selected curves of overcurrent elements (OCEs) in the design for a given fault current level. The user choses which OCEs to investigate, adds them to the results table and then enters the desired fault current in per unit.
The table displays:

- first column: the subcircuit path and the name of the OCE: *Subcircuit Path/OCE Name*

Warning: if the relay is in a subcircuit with multiple instances, only one of them is displayed since the settings are inherited for all other.

- Other columns: the tripping time in seconds for each protection level.
  - A1 (Phase A level 1), B1 and C1 are the A, B and C phase protections for level 1
  - A2, B2, C2 are phase protections for level 2.
  - N1 (Neutral level 1) and N2 are the zero-sequence protections for levels 1 and 2
  - Q1 (Negative sequence level 1), Q2 are the negative-sequence protections
  - G1, G2 are the Ground protections.

If one or several of the above protections are disabled in a relay, “N/A” is displayed in the corresponding box.
If the fault current is smaller than the pickup current of the level, “none” is displayed in the corresponding box.
The voltage restraint is not considered.

For fuses, the pre-arcing and total clearance times are displayed in the same cell (level A2), separated by '-' (see Figure 1-1). The melting curve is in the column of level A1.

Overcurrent elements	A1	A2	B1	B2	C1	C2
fuse	0.5	0.0612 - 0.12860	0.5	0.0612 - 0.12860	0.5	0.0612 - 0.12860

Figure 1-1 Display example for fuse.

2 Protection coordination tab

2.1 Selection of Overcurrent elements

- **Fault current**: Fault current in pu used for each device in tripping formula.
- Select an overcurrent element and click on the "+" button.

To remove an OCE from the Table, simply delete its name in the first column and click on the refresh button  .

2.2 Time-current curves

This section allows the user to plot the inverse curves in ScopeView and thus to visualize the coordination between OCEs. To proceed (for OCEs present in the Table):

1. Select the level to plot (Generate coordination graph data for protection level). Combined levels can be used, such as A1-2, and will appear on the same graph.
2. Click on **Plot TCC**

The resulting plots are shown in Figure 2-1 using the log-log scale selection in ScopeView.

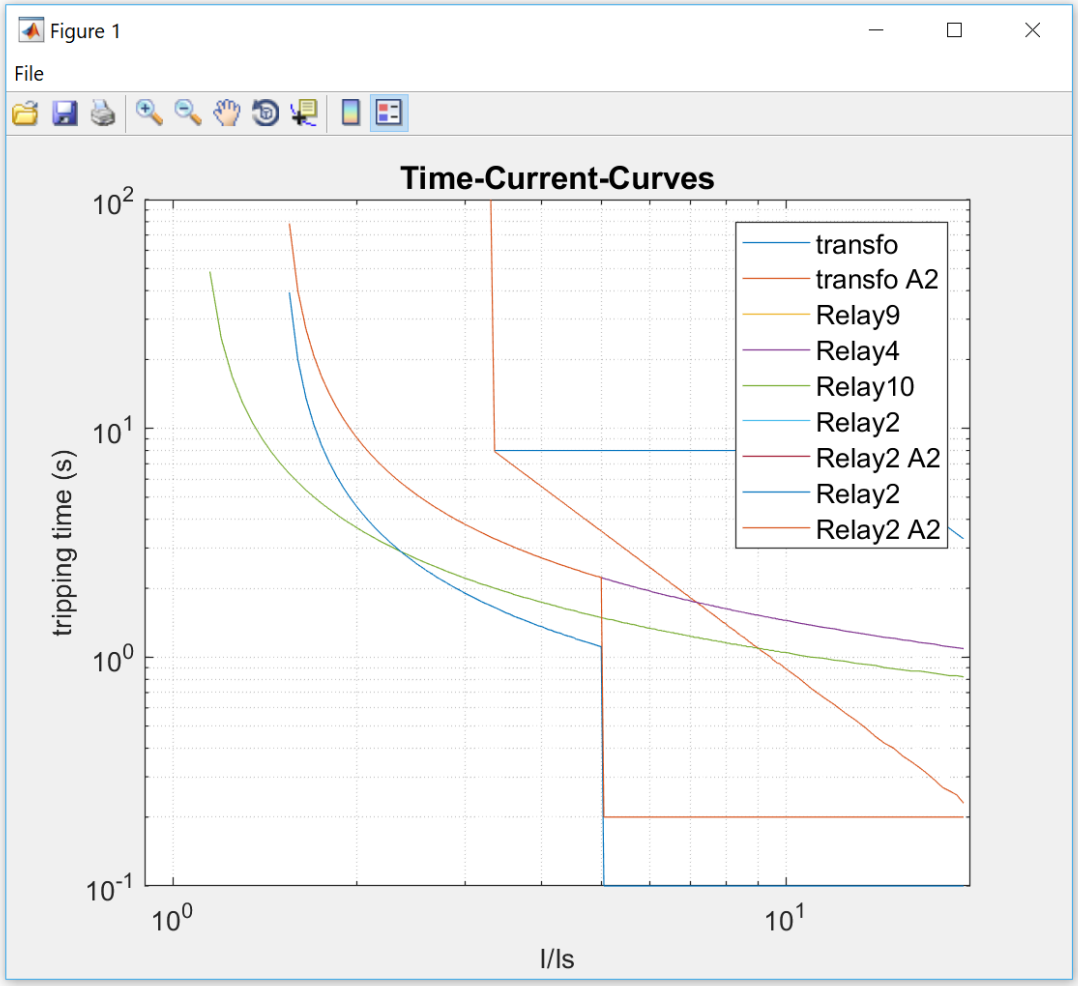


Figure 2-1 Sample time-current graphs for selected signals (coordination curves).

2.3 Plotting options

To display the options, click on 'Plotting options'. These options are self-explanatory.

- **I_{min}**: Minimum value on x-axis.
- **I_{max}**: Maximum value on x-axis.
- **Delta**: Calculation step for curve points.
- **Max tripping time to display**: Maximum value on the y-axis for the current points.
- **Value when $I < I_{pkp}$:** Value (x-axis) for the current points lower than the pickup current of the curve.

3 Applications

3.1 Transformers through-fault curves

For transformers, A1 is the curve from level 1, however A2 is the combination of both levels and, in the end, is the through-fault characteristic of the transformer.

3.2 Fuse curves

There are three curves for each fuse. The first one is the "Melting curve", the second is the "Pre-arc energy" and the third is the "Clearing energy".

3.3 Single phase fuses and thermal elements

Single phase fuses or thermal elements can be used for coordination with neutral or ground protections of relays. Therefore, when levels other than A1, A2, A1-2 are plotted, the curves of the single phase fuses and thermal elements for those levels are still displayed.