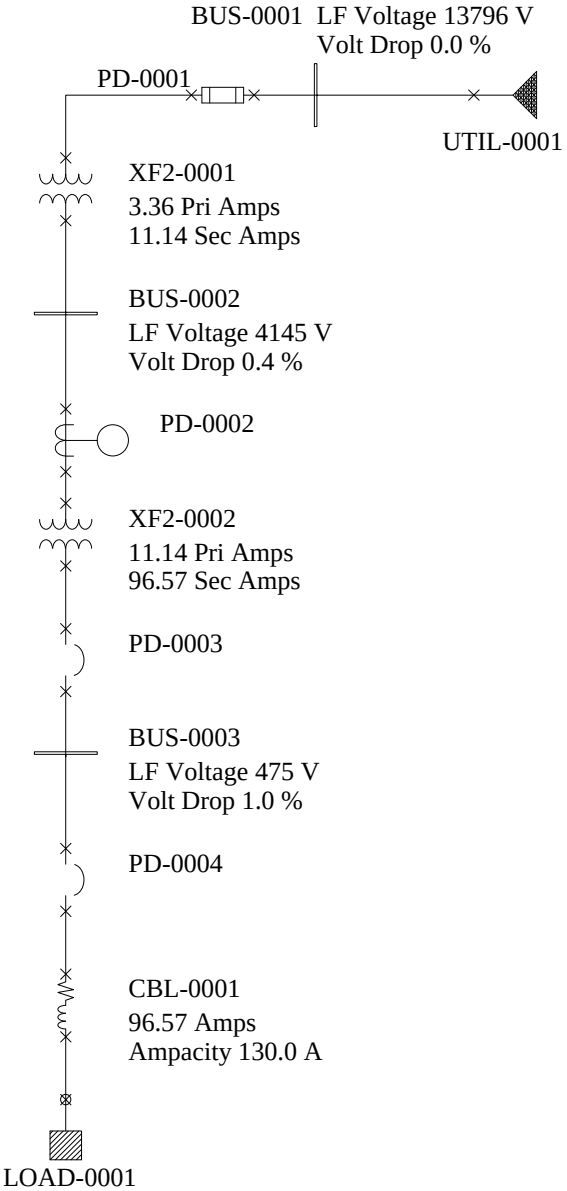
ECE471 INDUSTRIAL POWER SYSTEMS
Time-Current Co-ordination (TCC) Studies

We'll begin with the radial system that was used for load-flow analysis. It is reproduced below with protection devices added.



Now we have to add the appropriate data for each protective device.

Starting with PD-0001, which is a HV fuse that carries 3.36 A. Double-click on the symbol to enter the Component Editor and click on Library. Select Fuses - high voltage then select the Cutler-Hammer CX 15.5 kV 4C-40C fuse. If you go to the settings, you will see that 40C corresponds to the cartridge size and 4C corresponds to 4 A trip.

Select PD-0002, which is a relay that supervises a HV breaker (not shown). Click on the library button and you'll have to close the fuse selection and select Relays - Electronic and pick the Multilin SR745 with a 5 A CT rating. The OC Pickup and Ext Inverse setting should appear with the default settings, we will change these values later when we co-ordinate the devices.

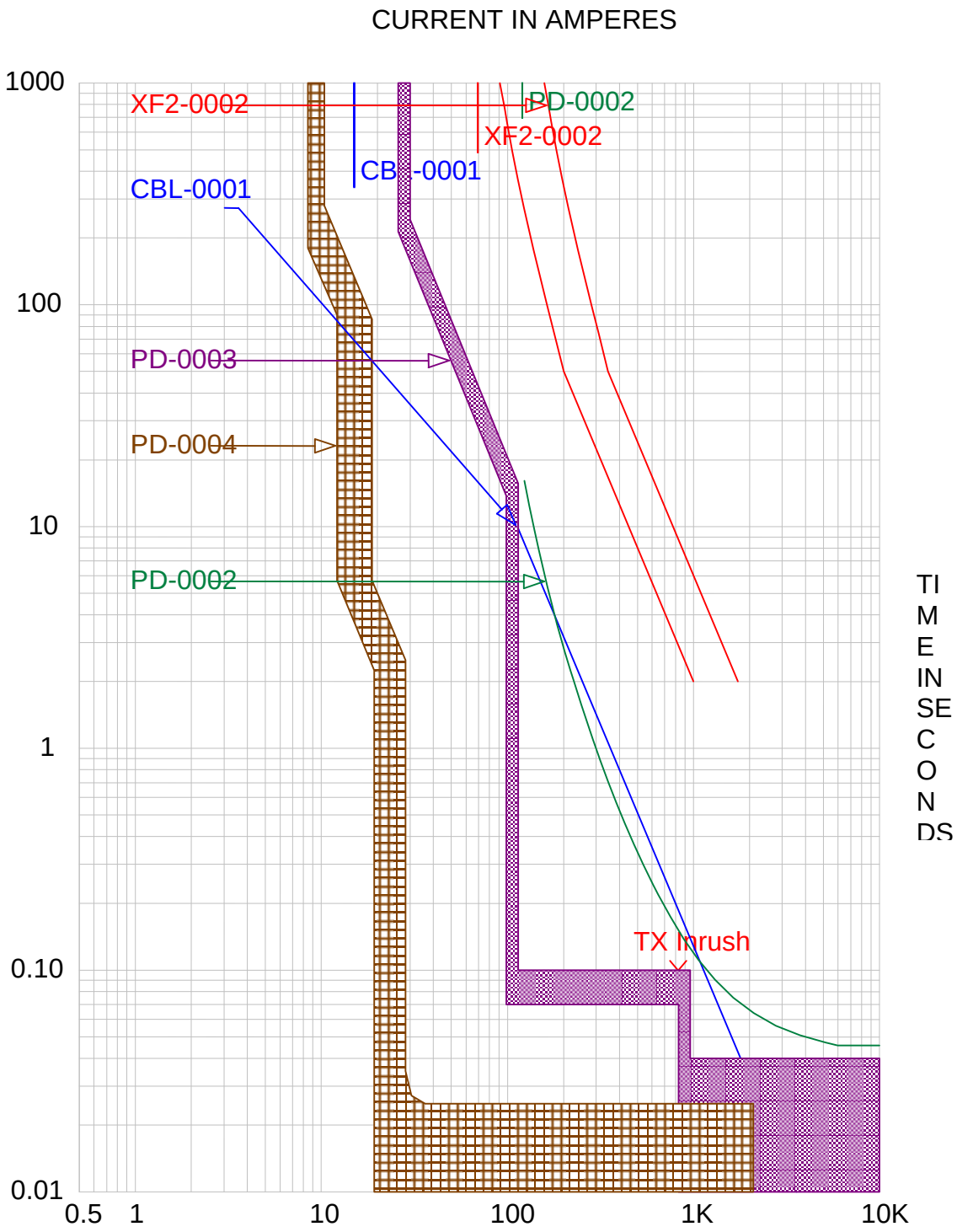
Select PD-0003, which is a LV breaker and click on the library button. Close Relays and select Low Voltage Breakers - Static Trip and the Square D MX Micrologic LS 100-800A (100A is the frame size). On the settings page go to "Frame:" and select:
MX 480V 800.0A (65.0,10.0)kA
This will enter the appropriate default data that we will fine-tune later.

Select PD-0004, which is another LV breaker and click on the library button, and select Low Voltage Breakers - Thermal Magnetic Molded Case and the GE SFHA Spectra 70-250A breaker.

Go back to the one-line diagram and select the area that includes all components from BUS-0002 down to the load (draw a box around them and they should be highlighted in blue).

These components will be transferred to a TCC drawing when you click the **right** mouse button and select the Go To TCC Drawing option. Enter the name for the new TCC drawing, e.g. TCC1 and a drawing similar to the one on the next page will appear.

Note that the current axis is referenced to 4160 V. This means that it is showing all currents with respect to the primary of XF2-0002.



TCC1.tcc Ref. Voltage: 4160 Current Scale x10^0 1Line001.drw

When co-coordinating devices it is good practice to begin by selecting the deepest component. In this case we want to protect CBL-0001, so on the diagram select the label for CBL-0001 and move it next to the cable damage curve to make it easier to see. The upstream device is PD-0004, so click on its label and under settings pick the 125 A trip (this is ~25% above the load current). Click on the **Redraw** button to update the drawing.

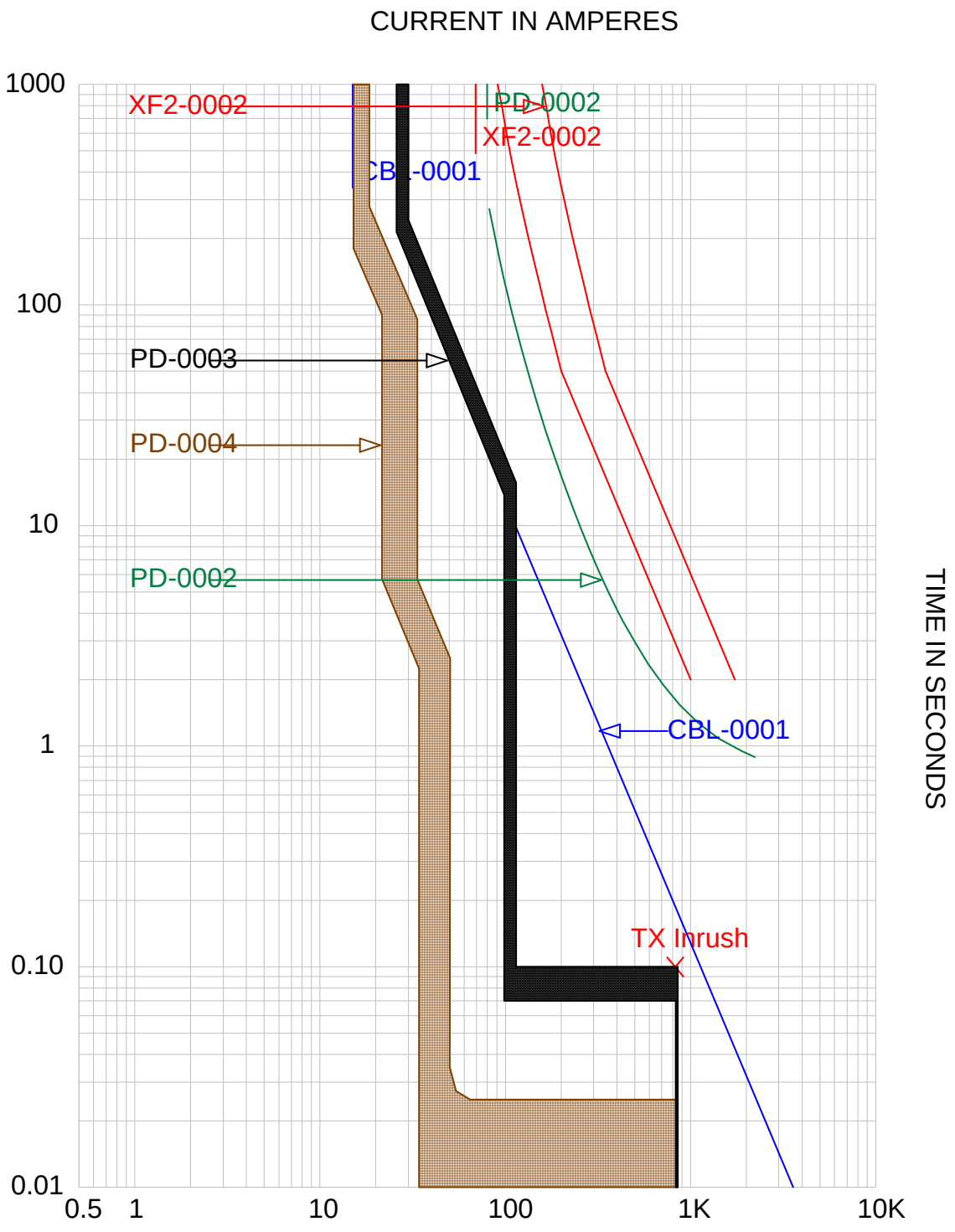
Select PD-0003 (the next upstream device). Notice that the TCC curve for this device is in between that of PD-0004 and the damage curve for CBL-0001 and so is adequate.

Select PD-0002, which is the transformer relay and shows up as a thin line on the drawing because HV breaker tolerances are tighter than those on LV breakers. We want the relay's pickup to be between the transformer FLA (~70 A) and the start of the transformer damage curve (~90 A) so a pickup of ~ 80 A will be good. You will have to move the cursor around the PD-0002 pickup line until it indicates left & right arrows before you can make this adjustment. The OC Pickup setting should be ~0.8 if this is in the correct position. Drag the time delay curve for the relay until it is just below the transformer damage curve. The Ext Inverse setting should be between 15 & 20 for this. Notice also that the curve should pass above the transformer inrush point, marked TX Inrush on the drawing; this allows the transformer to be energized without tripping the breaker.

The TCC drawing should look like the image on the next page.

To print a TCC drawing, select Document>Form Print. To import a TCC image into a Word document, select Document>Export then select Clipboard under Destination and the image will be placed on the clipboard ready to be pasted into your document.

Now we can go to the example system that has been used in class and start by coordinating the individual motor protection devices at MCC 1.



TCC1.tcc Ref. Voltage: 4160 Current Scale x10^0 1Line001.drw