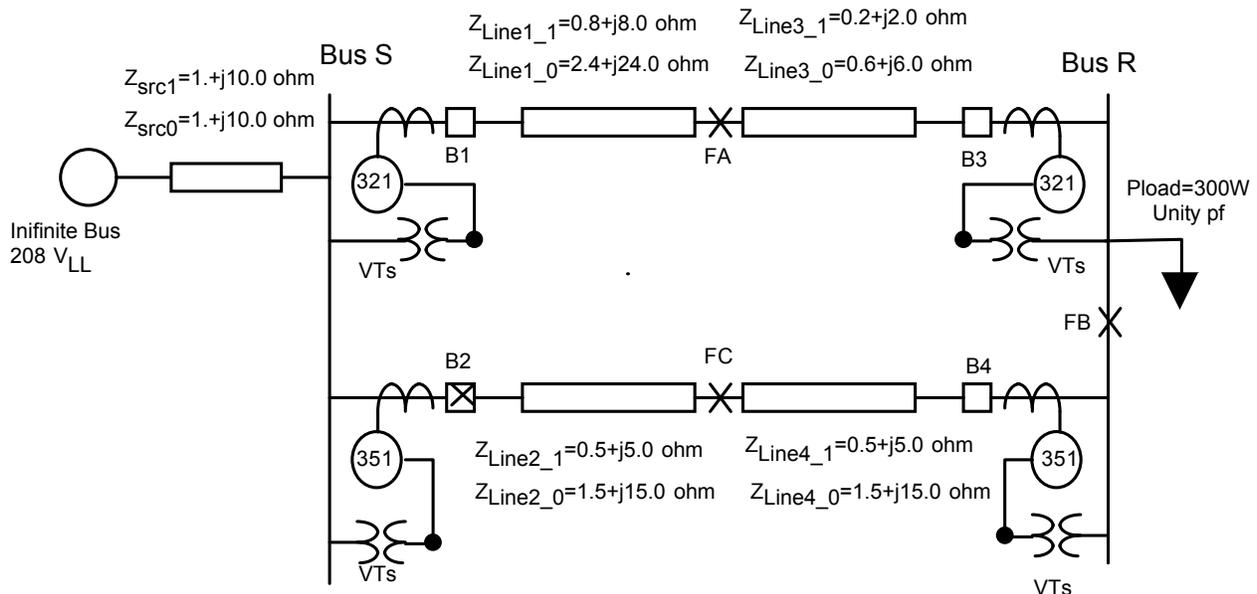


ECE 526: Lab 1

Due: Session 15 (March 2)

The simulated power system is configured as shown below, with a single source supplying two parallel lines. Each line segment has a series impedance of $1+j10 \Omega$, divided more or less equally between 10 taps. The source impedance can also be varied with taps and is set at its maximum.

- The simulated CT's have a CTR of 1:1
- The voltage transformers on the upper line have a VTR of 1:1



Please Note: breaker B2 is open, distance relay SEL 321 is used to provide 2-zone distance protection.

Lab 1 Procedure:

1. Determine relay settings for distance elements (phase and ground)
 - Instantaneous trip faults up to 80% of the upper line (Line 1 + Line 3) as shown above.
 - Time delayed trip (5 cycles) for faults between 80% and 150% (half way down the series set Line 2 + Line 4)

The phase and distance relay settings are as follows:

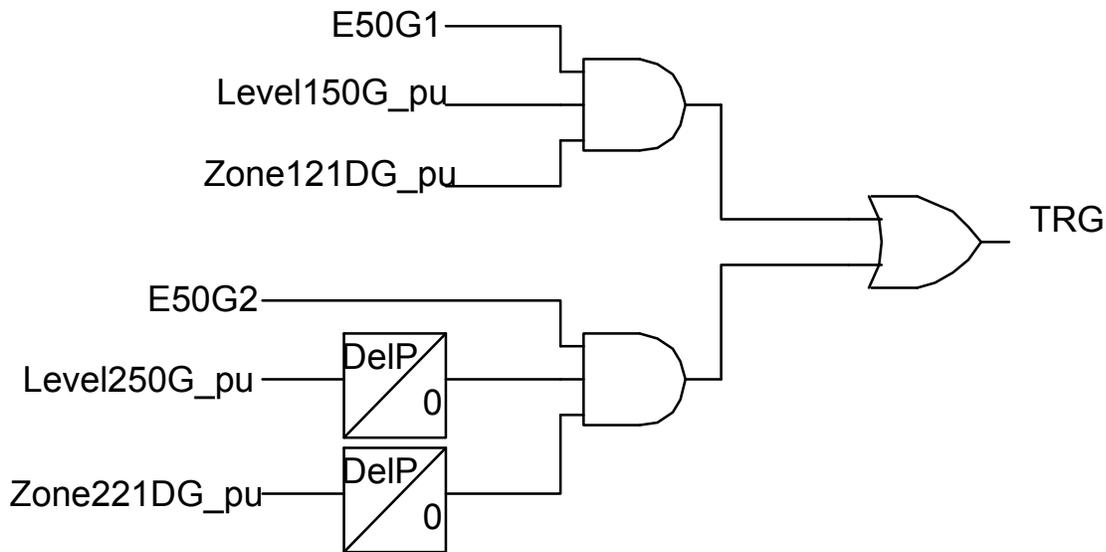
- a. Positive sequence line impedance
- b. Zero sequence line impedance
- c. The relay model will calculate k_0 based on Z_1 and Z_0 so you don't need to enter it.
- d. Percentage reach for zone 1 (default set at 75% of the line length, you should update this) for both ground and phase elements.
- e. Percentage reach for zone 2 (default set at 125% of the line length) for both ground and phase elements.

2. Determine relay settings for instantaneous overcurrent supervisory elements (phase and ground). In this case, the instantaneous elements are set to ensure that the distance elements are only active in the case of a fault. Therefore they should be set to a current above the maximum load current and below the minimum fault current you want to be able to cover for zone 1 or zone 2 (you have settings for each). The logic diagram is as shown in the figures below.

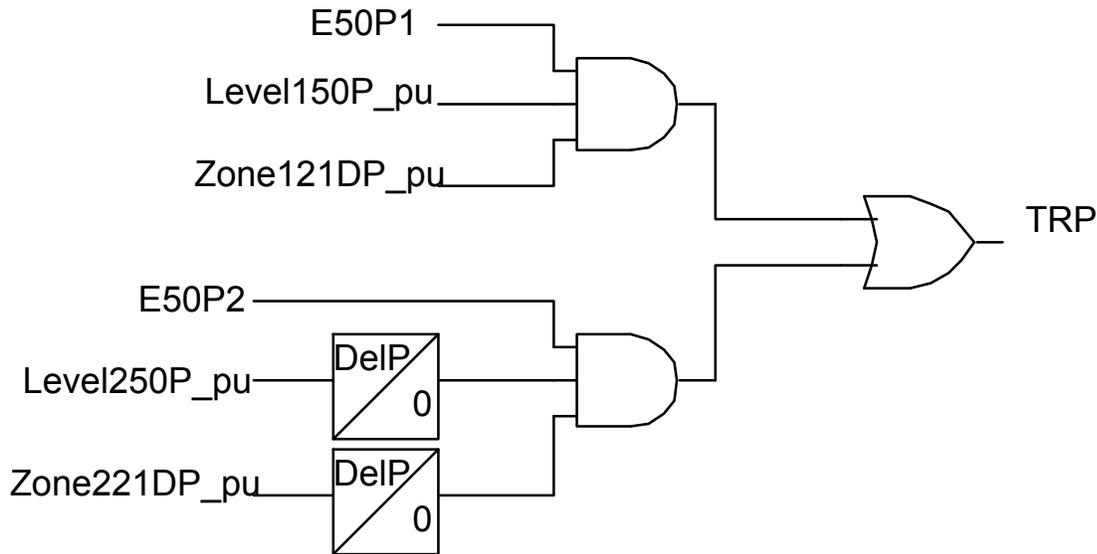
Relay settings:

- a. Enable 50P or 50G element overcurrent supervisors
- b. Set minimum overcurrent pickup for zone 1 ground and phase elements
- c. Set minimum overcurrent pickup for zone 2 ground and phase elements

Ground distance element logic diagram:



Phase distance element logic diagram:



TRIP = TRG and TRP

3. Modify trip equation at the end of this file (if needed).
4. Download COMTRADE files for faults at points FA, FB, and FC. The files for have 3 phase, SLG, LL, and DLG records at 75%, 83%, 100%, 145% and 155% of the line length. These will be placed on the web page as zip files (each with a *.hdr, *.cfg, *.dat) file.
5. Also download the COMTRADE files for Zone1RF, which have faults with non-zero fault resistance at different locations within the zone 1 reach.
6. Load each of the COMTRADE files into the MathCAD relay model and test your settings. It is better to underreach than overreach.
7. Comment on which levels of fault resistance cause the distance element to fail to pick up in zone 1 (note whether the overcurrent setting or the distance element reach is the problem).

Report:

1. Your report should list your relay settings
2. Show summaries from the MathCAD results demonstrating that the relay settings operate correctly. Possible show a few plots demonstrating the results (but not all cases!).