ECE 526: Homework #3

Due Session 17 (March 9)

1. The impedances for the system below are given in secondary ohms.

\[ V_S := 69.5V \cdot e^{j\cdot0\text{deg}} \text{ at } 60\text{Hz} \]

\[ V_R := 69.5V \cdot e^{j\cdot0\text{deg}} \text{ at } 60\text{Hz}, \]

\[ Z_{S1} := j\cdot1\text{ohm} \quad Z_{cap1} := -j\cdot0.8\text{ohm} \quad Z_{L1} := j\cdot1\text{ohm} \quad Z_{R1} := j\cdot0.4\text{ohm} \]

\[ Z_{S0} := j\cdot3\text{ohm} \quad Z_{cap0} := -j\cdot0.8\text{ohm} \quad Z_{L0} := j\cdot3\text{ohm} \quad Z_{R1} := j\cdot1.2\text{ohm} \]

Suppose a SLG fault occurs at 30% of the way from BUS1 to BUS2, do the following:

1. Plot phase A voltage profile, Bus and Line side VTs are shown
2. Plot negative sequence voltage profile, Bus and Line side VTs are shown
3. Determine the negative sequence currents seen at BUS 1 and BUS 2
4. Determine settings for Z2F and Z2R for a negative sequence directional element
5. Calculate what a directional element based on the angle between V1 and I1 would calculate in this case?

Reference: see [http://www.ece.uidaho.edu/ee/power/ECE525/](http://www.ece.uidaho.edu/ee/power/ECE525/)
Especially lecture 20 and the handout included in lecture 19

2. Repeat problem 1, for a fault at 10% of the line and:

\[ Z_{S1} := j\cdot0.3\text{ohm} \]

\[ Z_{S0} := j\cdot0.9\text{ohm} \]

3. Repeat problems 1 part A and B if the angle of the remote source is -2.5 degrees
\( I_{\text{remaining}} = I_{\text{light}} + I_{\text{dark}} \)

\( I_{\text{light}} = I_{\text{left}} - I_{\text{right}} \)

\( V_{\text{total}} = V_{\text{left}} + V_{\text{right}} \)

\( V = V_{\text{far left}} + V_{\text{far right}} \)
Supervision

- Relay calculates

\[ V_{\text{CALC}} = \frac{V_r}{V_{\text{CALC}}} \]

Block 2

element until
done -

calculation
to

\[ V_{\text{RELAY}} = 2 \ln \left( \frac{I_{a} + \text{watts}}{I_{a}} \right) \]

\[ \text{From measurements} \]

\[ I_{a}, 3I_{o} \]
\[ V_{46} = \frac{E_1 - (I_A + E_0 + \theta)}{I_A} \]

Look at the line graph.

Block Zone

In V Valeo > \Phi

Is active

Out \Phi > Valeo > \Phi
end of next line.

May end up reaching past...

whether capacitor inserted or not

Area (Back up zone 2)

— completely cover entire length of

Setting Zone 2
Zone 2 for commanded distance?

- Don't need some Zone 2 as
  back up zone if rely has
  multiple zone available
  
- More flexibility in reach
  setting
essential: CRT, P5CD/3ML/EXPS...

- Digital twin domain solutions are imperative
  - Consider non-long oscillations
    - Controller usage of
      - If relay has series operator compensation
        - Pay attention to
          - Be aware of
            - 4 mean channel
              - Talk opportunity of many populations
                - Created by person 4 - YC
                  - Account for uncertainty
                  - Series capacitor, 20k

08/15
Exercise 7.5

Interested

\[
V_{\text{calc}} = \left( \frac{E_a + 3E_b}{Z_l + jX_l} \right) Z_l + \frac{E_a + E_c}{jX_c}
\]

Close faults between caps

\[\theta = 35^\circ 7\]

\[\theta = 26\]

University of Idaho
Next Topic: Single Pole Tripping

- Enabling with protection
- Impacts on other elements

- SLG -> Trip faulted phase only
  - Reclose only, phase B

How guaranteed fault has cleared?
- Longer reclose time