

ECEN 616 Project Part 1, Fall 2022

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Instructions for the Project

There are three parts to this project, which will be introduced one per week. This document describes part 1. The three parts build on each other as you build one combined EMTP model. Turn in a two-page report that describes the circuits, study results, and answers to questions from each part. The reports are due by email on Wednesday, Nov. 16th, at 12 noon. There will be in-class discussion of the project on Nov 16th and 18th.

Description of Circuit

For the project, we are modeling transients associated with three 500 kV transmission substations: Alfa, Bravo, and Charlie. Alfa substation can be modeled as an equivalent source, with a three-phase short circuit strength of 5000 MVA and X/R ratio of 20.

There is a 50 km, double-circuit transmission line connecting Alfa and Bravo substations. Each phase contains a bundle of two ACSR conductors, separated by 26 cm. The conductors have an outside diameter of 2.1 cm and a dc resistance of 0.137 Ohms/km. Each circuit is organized vertically, with the middle phase 18 m above the ground, and the phases separated by 5 m each. The two circuits are separated horizontally by 9.6 m. There are two shield wires 0.945 cm in diameter, with a dc resistance of 3.375 cm, located 4 m above the top phases, centered and separated by 7.4 m. Assume ground return resistivity is 100 Ohm-meters. Use a frequency-dependent line model with validity from 0.1 Hz to 10 MHz.

At Bravo substation, there is a capacitor bank installed, connected wye and solidly grounded, providing 70 Mvar of reactive power to the system.

Charlie substation will be used for parts 2 and 3.

Studies to Run

1. Find the maximum overvoltage when switching in the second circuit of the transmission line. Assume the first circuit is already switched in, and the capacitor bank is switched out. Both lines can be open circuit at the Bravo end.
2. Find the maximum switching surge current for switching the capacitor in, with both transmission lines in service. Find the maximum surge current both at Alfa and Bravo substations.
3. Explore the impact of adding a closing resistor to switch in the capacitor bank. Roughly what size resistor would you recommend?