PSCAD Cookbook

Reactor Switching Study

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8.1 Reactor Switching Study

Motivation

This case is used to illustrate the effects of reactor switching. A system becomes isolated into two parts when a breaker interrupts the current to a reactor. The two isolated parts of the system oscillate at their respective natural frequencies. Since the stray capacitances are typically very small, high natural frequencies are possible. This is likely to impose a fast rising voltage transient across the circuit breaker (TRV). This can pose problems to the circuit breaker and cause restrike of the arc that is being interrupted.

System Overview

Figure 1 illustrates the circuit under consideration. This figure models a power system connected to a reactor through a breaker. Here the voltage source and inductor L_1 together form the Thevenin equivalent circuit model of the power system, and L_2 models the innate inductive impedance of the reactor. Capacitors C_1 and C_2 account for the stray capacitance of a transformer winding (connected to the power system) and the reactor winding, respectively. Also, the resistor R accounts for the reactor winding loss. The breaker is used to interrupt the current to the reactor, isolating the two systems.

This essentially is the situation of a normal reactor switching (possibly to regulate the voltage on the 138 kV (3 φ) bus).

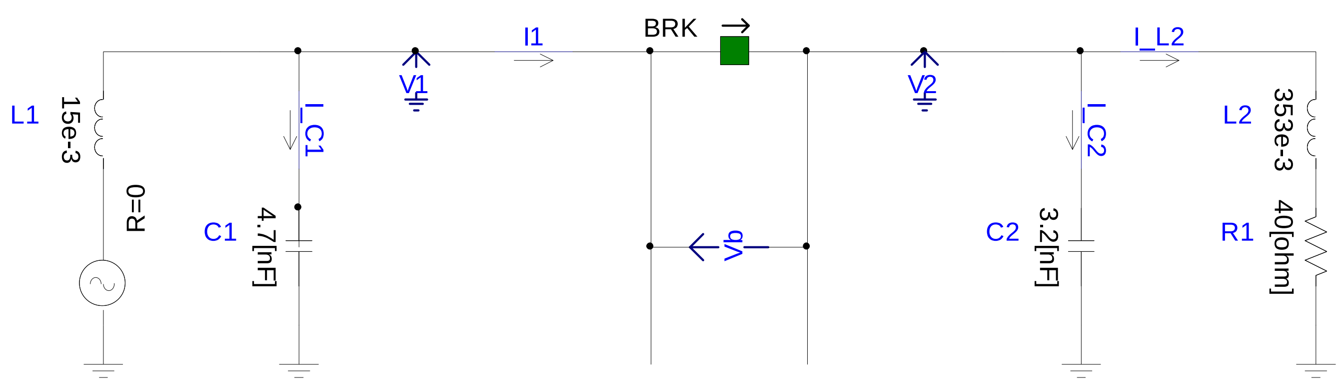

Figure 1: System Circuit Diagram

Simulation Results

Note the voltage appearing across the breaker immediately following the current interruption (Figure 2 and Figure 3). The voltage across the breaker (V_b) plays an important role in determining if the breaker will interrupt the circuit successfully. V_b is commonly referred to as the 'transient recovery voltage' or TRV.

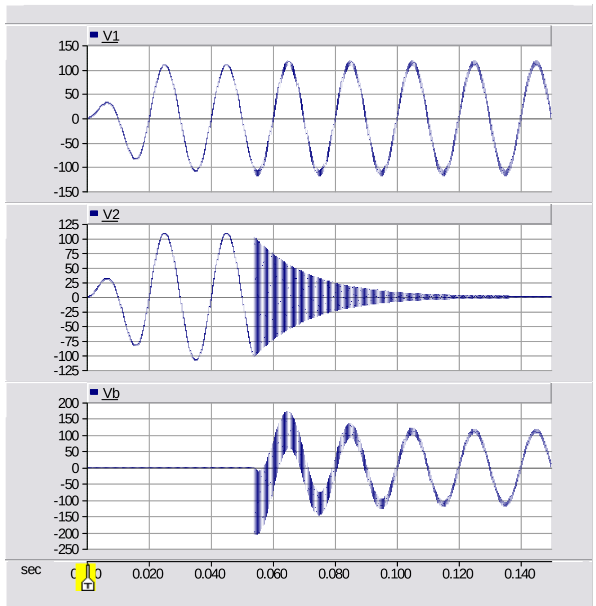

Figure 2: Response of the System to Breaker Opening

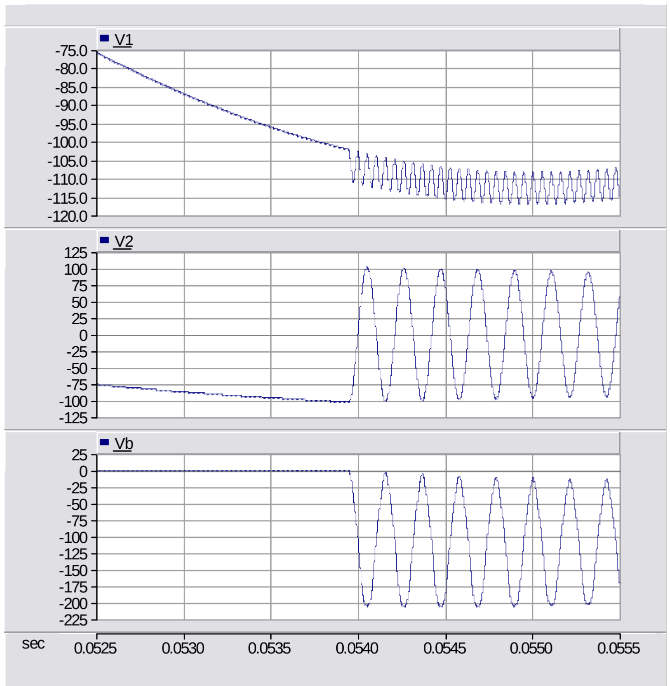

Figure 3: Response of the System to Breaker Opening (a Closer View)

With the breaker open, both systems form second order circuits with resonant a frequency $f_o = \frac{1}{2\pi\sqrt{LC}}$. The power system side has $f_{o1} = 19\ kHz\ (T_{o1} = 53\ \mu s)$ while the reactor side has $f_{o2} = 4.7\ kHz\ (T_{o2} = 212.8\ \mu s)$. Figure 4 displays the results of the PSCAD simulation for the circuits; the results are consistent with the theoretical values.

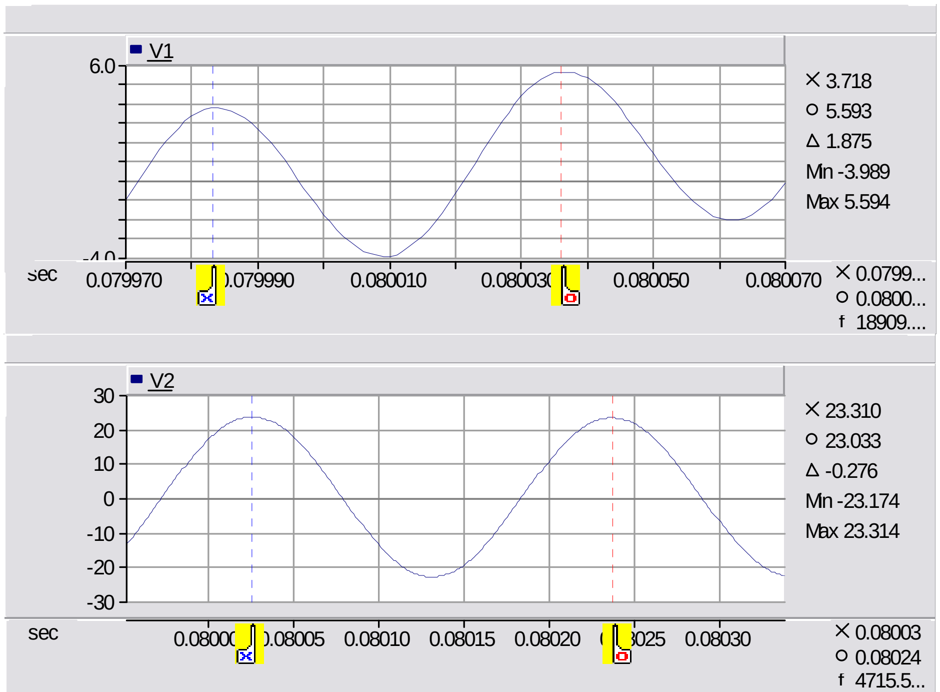

Figure 4: Systems Oscillating at their Respective Natural Frequencies

Notable Features

The following are notable features of this model:

- The Voltage V_b is the 'transient recovery voltage' TRV.
- The maximum TRV peak possible is twice the value of the input voltage.

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Refer to PSCAD case: *Reactor_Switching.pscx*

DOCUMENT TRACKING

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0	Initial	01/Jun/2013