Indication Transient Recovery Voltage

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Introduction

The TRV (Transient Recovery Voltage) is the voltage that appears between the poles of breaker when it interrupts a current. This voltage can create an arc that conduct the current back.

This TRV depends on several factors, like the fault that triggered the opening and the capacitance of the electrical component the breaker is connected to.

The TRV standard is defined by two curves:

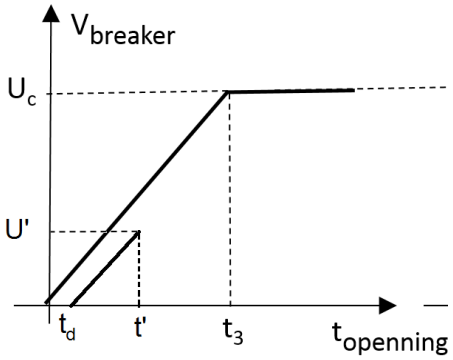

Figure 1 Shape of TRV envelop curves

The breaker voltage must be below the bigger one and has to cross the delayed one.

The faults whose overvoltage peak is the highest are the 3-phases terminal faults. The faults whose initial rate of rise is the highest are the 3-phases Short-Line faults. As they represent the two extreme cases, the two needed simulations are with the 2 faults described below.

For each one of the two faults, 3-phase Terminal Fault and 3-phase Short-Line Fault, the test method includes the four following steps:

1. Step 1: Ignition point

Place the Ignition Point device below to indicate to EMTP-RV where the default happens.

Figure 2 Device of Ignition Point

– If the fault is a terminal fault, place it where it will happen

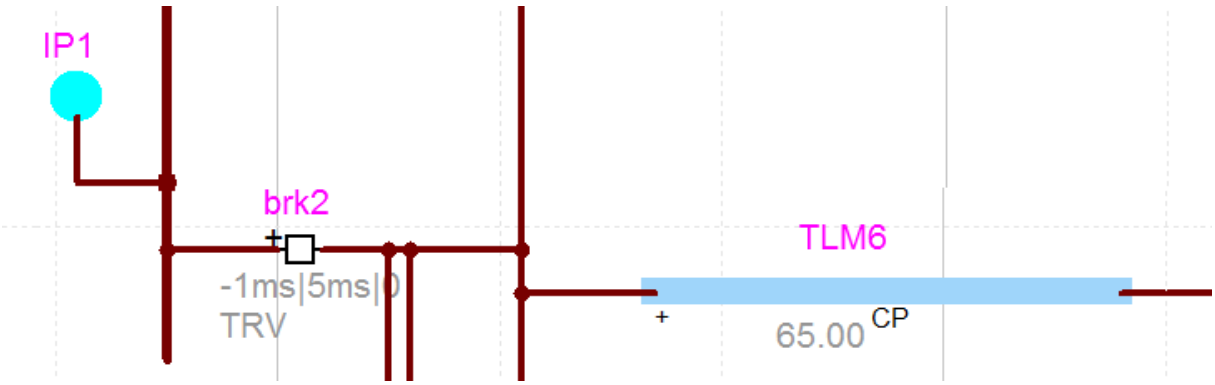

Figure 3 Example of connection for a 3-phase Terminal fault analysis

– If the fault is a Short-Line fault, place it after the line where the SLF will happen

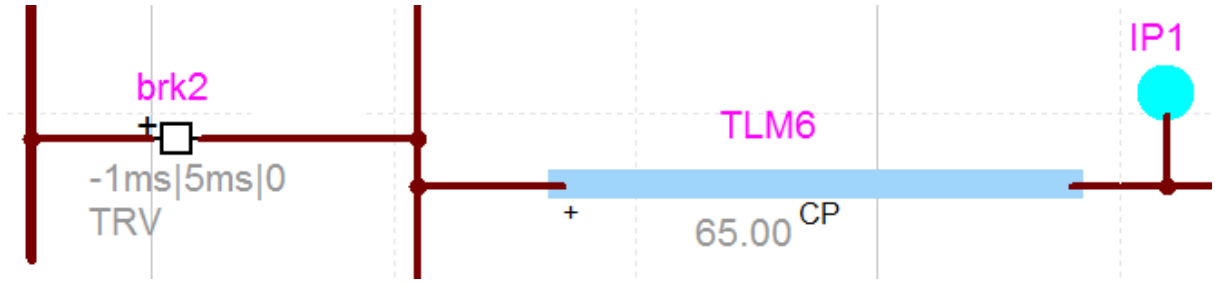

Figure 4 Example of connection for a 3-phase short line fault analysis

2. Step 2: Stray capacitances

As previously said, the capacitances of the components have an important influence on the TRV. That is why, the first step is to add a special component to represent these stray capacitances as shown in the figure 1 below:

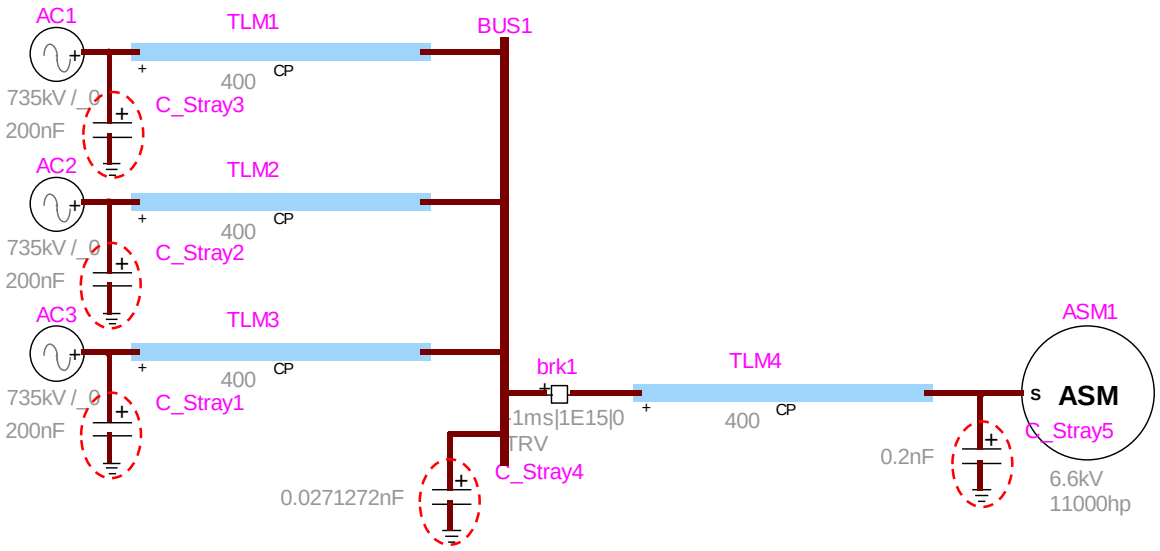

Figure 5 Example of connection of "Stray capacitance" devices

NB: No supplementary device is required for the breaker whose TRV is studied because it has already been taken into account in the device representing the breaker.

Moreover, as the capacitance of the line is very well represented in EMTP-RV, it is useless to add another.

3. Step 3: Breaker

A special breaker, named “breaker(TRV)”, must be used with this toolbox. For more information, please refer to the help File of this device.

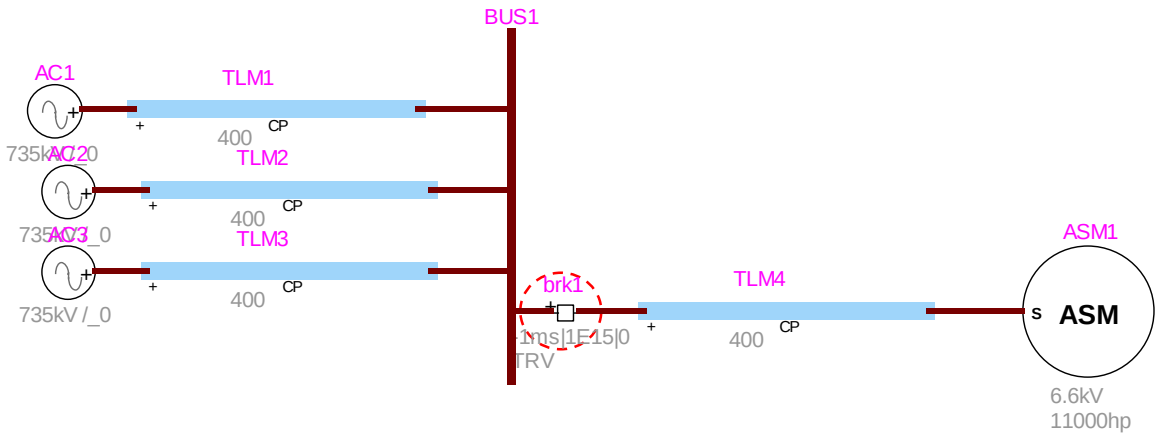

Figure 6 Example of connection of "breaker(TRV)" devices

In order to parameter to your breaker:

- Indicate the opening time

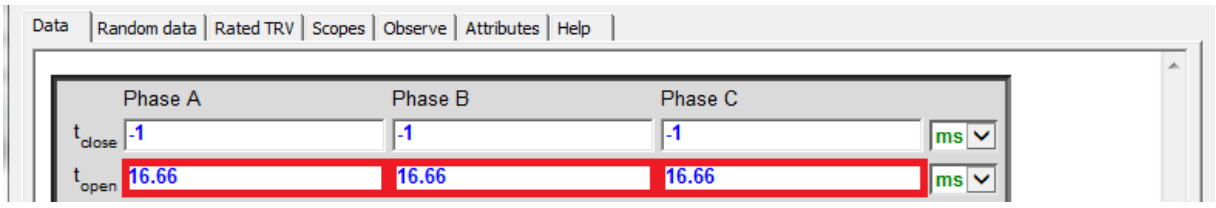

Figure 7 Data window of breaker(TRV)

4. Step 4: TRV analysis

According to IEEE Std C37.011™-2005, two tests have to be made to validate the TRV test:

- A three phase terminal fault

If this test is conclusive:

- A Short Line fault

To launch the TRV analysis, add an instance of “Launch TRV analysis” and double-click on it.

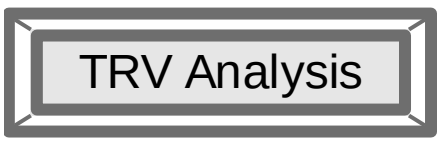

Figure 8 "Launch a TRV analysis" device

- If the checkbox “Load a previously calculated TRV Case” is not checked, three fields are available:
  Breaker: select the breaker on which the TRV analysis will be done
  Type of fault: select if the fault is a terminal fault or a Short Line fault
    - If the fault is a **Short Line Fault**:
      Distance from breaker to fault: Indicates the distance from the point of connection between the line and the breaker and the fault. This value can be written in proportion of the line length
      Click on “OK”
      A fault will be placed and a simulation will run. A folder will be created in your design’s folder called “TRV_*Name of your design_number of the TRV analysis*”
      Ex: the third TRV study of the design “Circuit1” is named “TRV_Circuit1_3”
- If the checkbox is checked, one field is available:
  Load a case: select a case you want to analyze

Three graphs (one for each phase) will be plotted with in ScopeView :

- **TRV_without_delay_time :** The TRV envelop
- **TRV_td:** The delayed curve
- **Minus_TRV_without_delay_time :** The opposite of the TRV envelop
- **Minus_TRV_td:** The opposite of the delayed curve
- ***Name_of_the_phase:*** The actual voltage

Nine .txt files (three files by phase) will be created in the case folder:

- **TRV_without_delay_time:** the TRV envelop
- **TRV_td:** the delayed curve
- **Voltage:** the actual voltage

(Other files will be created but are for internal purpose)
They contain two series of points. The first one represents the time in s. The second one represents the data.

A report is generated. This report detailed every non-conformity found during the simulation and conclude whether the system comply with the standards.