The PSCAD Component “Reignition”

1. Introduction

This component is designed to simulate the reignition phenomena during the breaker open operation.

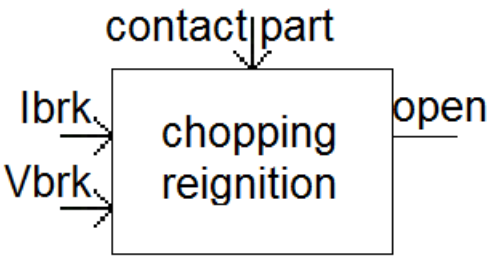


Figure 1 the “reignition” component

Figure 1 shows the component “reignition”. There are three input and one output signals:

“u” (real): the voltage cross the breaker, i.e., the arc voltage.

“i” (real): the breaker current , i.e., the arc current.

“contact part” (integer): the signal indicates the contact parts (arcing starts). When it turns to 1 from 0, the contact starts separate.

“open” (integer): output signal to control an ideal breaker. When it is 0, the break is close, when it turns to 1, the breaker will open immediately.

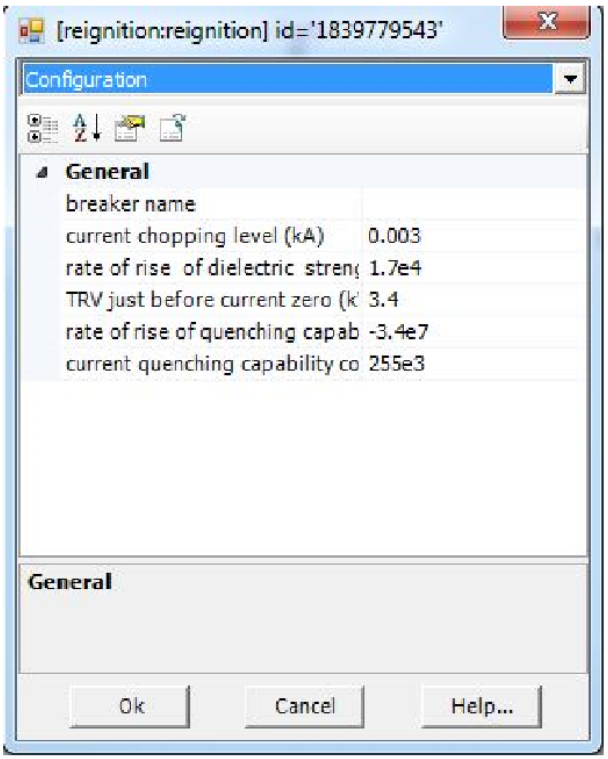


Figure 2 “breaker arc” input parameters

Input parameters:

General information

Breaker arc name	text	the name of the breaker name.
Current chopping level (kA)	real	the current chopping level.
Rate of rise if the dielectric strength (kV/s)	real	
TRV just before current zero (kV)	real	
The rate of rise of VCB HF quenching capability (kA/s2)	real	
Quenching capability just before the contact separation (kA/s)	real	

2. Example of reignition/current chopping

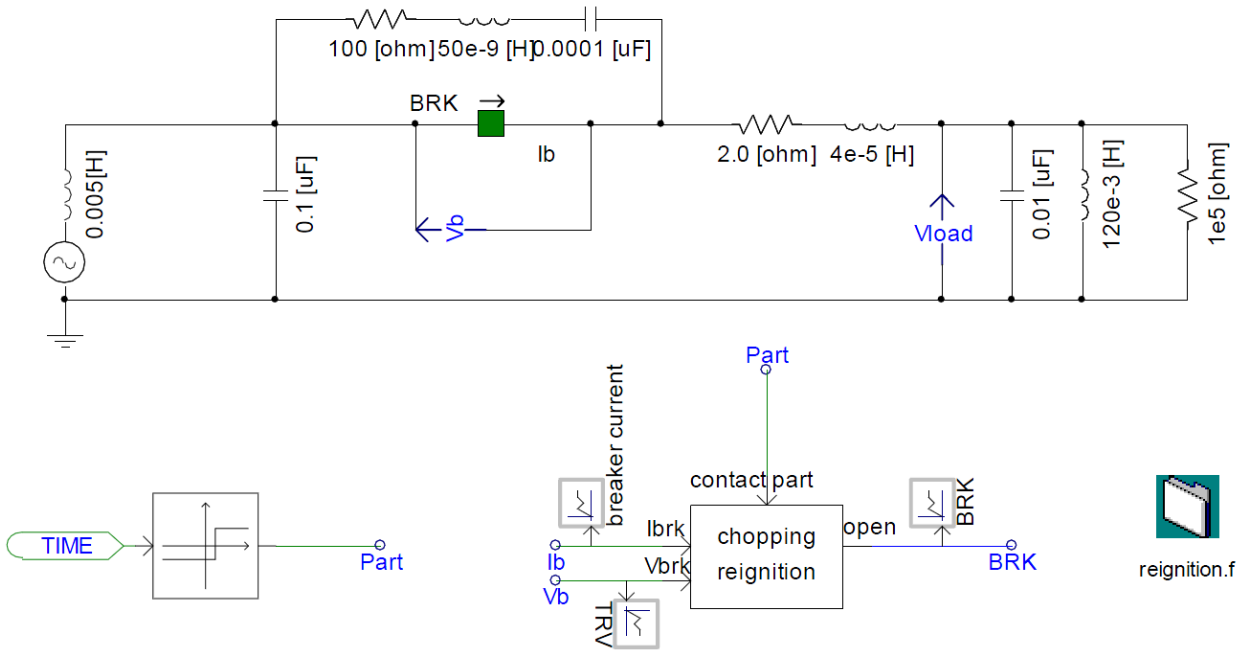
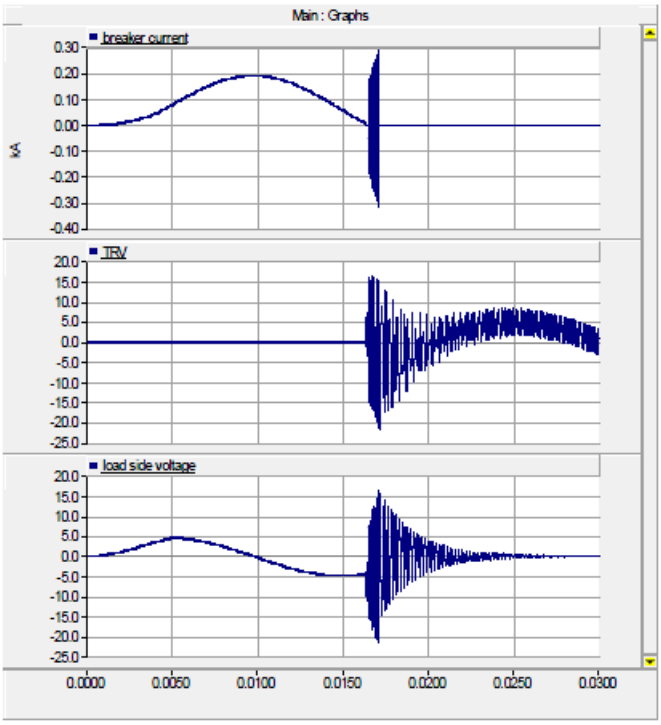


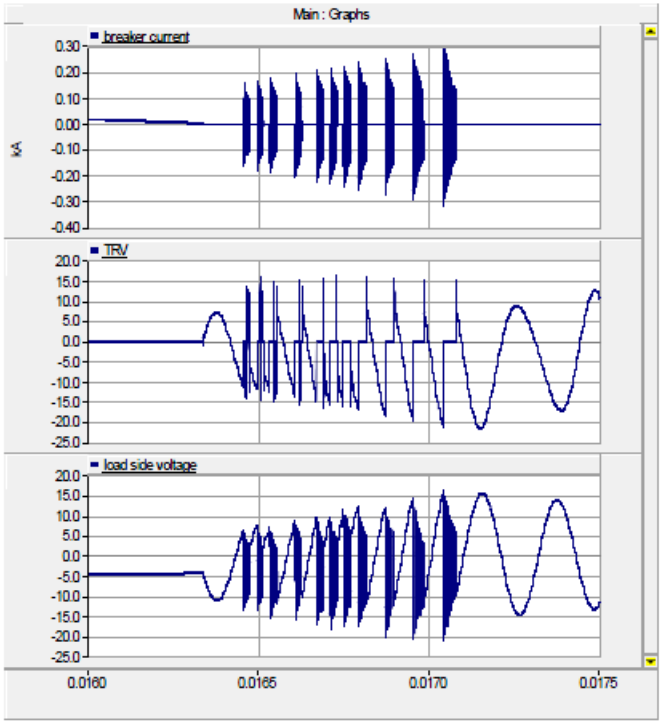
Figure 3 circuit of current chopping and reignition

A simple example is created in PSCAD to demonstrate the effects of current chopping and multiple reignition of the VCB.

See Figure 3, the test circuit refers to Dr Popov's Ph.D thesis [3] and Olof Karlen's work [4]. In the single phase circuit, the source (50Hz, 3.45kV rms) is connected by a VCB with a 0.005h reactor and a 0.1uf capacitor representing the source side, cable and busbars. 2Ω and 0.04mh represent the cable connection to the load. 0.01uf is the sum of the cable and load capacitance. 120mh is the load inductance. 100Ω, 50nh and 0.1nf represent the parasitic parameters of the gap.

The simulation results are shown in Figure 4. The "Part" signal is given at 0.016s, the instant of the contacts starting to part. The current is chopped at 0.01634s. Reignition occurs at 0.01645s. The multiple reignition lasts to 0.017s when the current is successfully interrupted. Note that the high frequency current component is much larger than the fundamental component at reignition instant, and the voltage escalates during the multiple reignition period.


Main : Graphs
breaker current
0.30
0.20
0.10
0.00
-0.10
-0.20
-0.30
-0.40
kA
TRV
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
load side voltage
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
0.0000
0.0050
0.0100
0.0150
0.0200
0.0250
0.0300


Main : Graphs
breaker current
0.30
0.20
0.10
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-0.10
-0.20
-0.30
-0.40
kA
TRV
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
load side voltage
20.0
15.0
10.0
5.0
0.0
-5.0
-10.0
-15.0
-20.0
-25.0
0.0160
0.0165
0.0170
0.0175

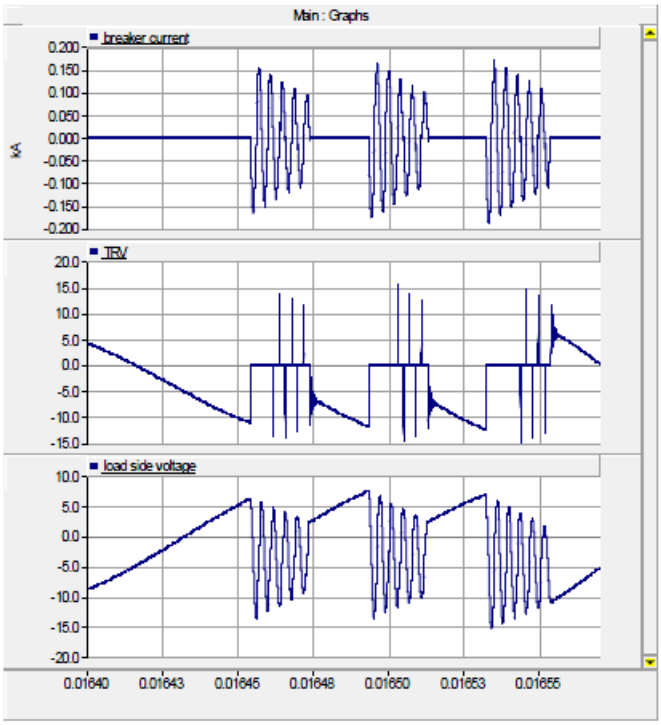

Figure 4 the current chopping and reignition of the VCB

References

1. IEC 60050-441(1984): "International Vocabulary Switchgear, Control Gear and Fuses".

2. P Mietek T. Glinkowski, Moises R. Guiterrez, Dieter Braun, "Voltage Escalation and Reignition Behaviour of Vacuum Generator Circuit Breaker During Load Shedding", IEEE Trans. On power delivery. Vol. 12, No. 1, Jan, 1997, pp. 219-226.

3. M. Popov, "Switching Three-Phase Distribution Transformers with a Vacuum Circuit Breaker, Analysis of Overvoltages and the Protection of the Equipment", PhD Thesis, Delft University of Technology, 2002, ISBN 90-9016124-4.

4. O.Karlen, "Vacuum circuit breaker model in PSCAD/EMTDC"

DOCUMENT TRACKING

Rev.	Description	Date
0	Initial	21/Jun/2016
1	Rebranded to new MHI branding guidelines	20/Sep/2018

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