SIEMENS

TechTopics No. 73

Generator circuit breaker applications - transient recovery voltage

TechTopics No. 71 discussed the major issues that make a circuit breaker application for a large generator quite different from a normal circuit breaker application. For convenience, a normal circuit breaker application will be referred to as a "distribution application," but this can include transformer applications, motor feeders, bus tie applications, capacitor switching and others. This issue of TechTopics explores one aspect of generator circuit breaker applications, very high transient recovery voltages (TRV), in more detail.

ANSI/IEEE C37.06-2009 is the standard for distribution circuit breakers. It replaced ANSI C37.06-2000. C37.06 shows transient recovery voltage values that distribution circuit breakers must withstand during the short-circuit switching tests required by IEEE C37.09. C37.06 includes transient recovery voltage values harmonized with the values in IEC 62271-100 and also uses the method of definition of the TRV waveshape that is used in the IEC standards.

IEEE C37.013 gives the TRV values for generator circuit breaker applications, but uses different variables to describe the TRV waveshape. The revision of C37.013 began in early 2009, and the TRV representation will be harmonized with that in the new C37.06 document, as well as with the IEC representation. The revision of C37.013 is anticipated in 2015, and will be redesigned as ANSI/IEEE 62271-37-013, a dual-logo IEEE and IEC document.

The values in the tables are not strictly comparable, but are nonetheless enlightening. The following table lists TRV values for distribution and for generator circuit breakers.

As mentioned, the TRV values have somewhat different meanings, but this is a matter of the details. A glance at the rate of rise of recovery voltage (RRRV) values in the tables will readily show that the rate of rise of TRV requirements for generator circuit breakers are much more severe than for distribution circuit breaker applications.

Circuit breaker type	Distribution[1]	Generator[2]	
Standard	IEEE C37.06	IEEE C37.013a-2007	
Source or type	T100, Class S2	System source	Generator source
Rated maximum voltage, kV	15	15	15
TRV peak value, kV	u_c = 29.2 kV	E_2 = 1.84 V = 27.6 kV	E_2 = 1.84 V = 27.6 kV
Time to peak, µs	t_3 = 32 µs[3]	T_2 = 0.62 V = 9.3 µs	T_2 = 1.35 V = 20.3 µs
RRRV, kV/µs	0.92 kV/µs	3.5 kV/µs	1.6 kV/µs

Footnotes:

1. TRV peak value (u_c) interpolated for rated maximum voltage V = 15.0 kV.
2. Values selected from tables in IEEE C37.013a-2007 for transformer (system) up to 100 MVA and generator up to 100 MVA.
3. New t_3 value is approximately 1.138 x historic T_2 value.

Circuit breaker type	Distribution[1]	Generator[2]
Standard	IEEE C37.06	IEEE C37.013a-2007
Source or type	Out-of-phase, Class S2	Out-of-phase
Rated maximum voltage, kV	15	15
TRV peak value, kV	u_c = 28.2 kV[1]	E_2 = 2.6 V = 39.0 kV
Time to peak, µs	t_3 = 63 µs[3]	T_2 = 0.892 V = 13.4 µs
RRRV, kV/µs	0.62 kV/µs	3.3 kV/µs

Footnotes:

1. TRV peak value (u_c) interpolated for rated maximum voltage V = 15.0 kV.
2. Values selected from tables in IEEE C37.013a-2007 for transformer (system) up to 100 MVA and generator up to 100 MVA.
3. New t_3 value is approximately 1.138 x historic T_2 value.

Siemens Industry, Inc.
7000 Siemens Road
Wendell, NC 27591

Subject to change without prior notice.
Order No.: IC1000-F320-A265-X-4A00

For more information, contact: +1 (800) 347-6659

www.usa.siemens.com/techtopics