VAH

Generator Circuit Breaker

According to IEEE

PM100853

PM100854

At 17.5 kV, VAH can switch:
- a rated short-circuit breaking current of 63 kA
- rated currents up to 8,000 A

The extremely robust and “open” construction design allows air cooling of the pole sections. This permits increased ratings for high mechanical and electrical switching cycles, high insulation level and high normal currents.

Schneider Electric`s VAH circuit breaker meets the requirements of the latest IEEE C37.013 standards. It has been referenced and installed in industrial processes all over the world.

Whether for power plants or generator switchboards, you need a flexible yet robust circuit breaker for high mechanical and electrical switching applications.

Perfect for modernization and extension

Since Schneider Electric was one of the first to develop and manufacture circuit breakers with vacuum interrupters, our expertise in this field allows us to complete the VAH product range with a high performance indoor generator circuit breaker.

This VAH vacuum circuit breaker with rated short circuit currents up to 63 kA has been specifically developed to face high mechanical and electrical switching applications. VAH is also an ideal circuit breaker solution for OEMs dealing with power generation projects.

These circuit breakers are designed for rated voltages up to 17.5 kV and for a rated peak lightning withstand voltage of 110 kV. The VAH circuit breakers are flexible for fixed mounted installation or on withdrawable trucks. They are particularly suited for modernizing or extending existing systems.

CUSTOMER BENEFITS

- Extremely robust construction
- Ideal for high currents thanks to natural air-cooling
- Special customized solutions available on request
- Minimum maintenance
- Worldwide Service support

Schneider Electric

To protect two expensive network components according to IEEE C37.013

Generator circuits are designed to minimize power losses of the system. They experience conditions that are more demanding than those in normal distribution circuits. The special characteristics of generator circuits require specifically purpose-designed and tested circuit breakers for those conditions. These performance requirements are specified in IEEE C37.013 used worldwide since no other standards on generator circuit breakers exist.

The generator circuit breaker has to protect two large and expensive system components, the transfomers and the generators, against damages in case of failure. It is installed close to the transformer and close to the generator, each with high inductive impedance. The installation is done with short and large conductors of very low capacitive impedance.

...VAH ideal for small, packaged power plants

Traditional generator circuit breakers in large generating stations are using SF6 gas as dielectric. In smaller power stations, the use of vacuum technology results in smaller circuit breakers which provide an optimized and more cost-efficient solution. Many smaller decentralized power stations located in the industry or in local smart grids have been installed during the past few years.

Designed and type-tested in accordance with the criterias of IEEE C37.013, VAH is ideal for smaller packaged power plants with smaller generators (up to 200 MVA) as a local source of power requires generator circuit breakers in the low and medium range.

For both large and small generator circuits, consideration must be given to the main system characteristics:

- High continuous current levels
- Fault current characteristic
  - Transformer/system-fed faults
  - Generator-fed faults
- Special voltage conditions
  - Very fast rate of rise of recovery voltage (RRRV)
  - Out-of-phase switching

High continuous current levels

Generator circuit breakers must be able to handle high continuous current levels. Schneider Electric VAH Circuit Breaker is designed to reliably operate up to 5000 A, cooled by the natural convection of the ambient air (8000 A with fan cooling).

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Characteristic of fault currents

Transformer/System-fed fault currents

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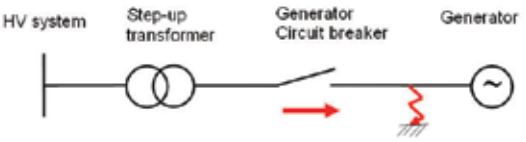

a

The short-circuit fed by the transformer (see figure above) on the generator side leads to high thermal and mechanical stresses on the vacuum interrupters due to the high short circuit current level.

To clear these kinds of faults, Generator Circuit Breakers are tested for interrupting not only the high symmetrical fault current of up to 63 kA, but also the higher asymmetrical fault currents with a minimum of 50% DC component as required in IEEE C37.013. The VAH generator circuit breaker is tested for asymmetrical fault currents of 63 kA and a DC component of 75%.

Generator-fed fault currents

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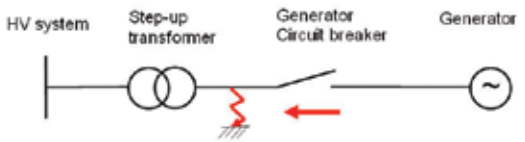

b

If there is a short-circuit fed by the generator (see location “b”) on the transformer side, the generator breaker experiences a special phenomena called “Delayed Current Zero” (see figure beside).

With respect to the transient time constants of the generator, the AC component of the short circuit may decay faster than the DC component, resulting in the asymmetrical fault current in which the DC component can be higher than 100%. The asymmetrical fault current peak becomes so high and its decay becomes so slow, that the current zero is delayed for several cycles.

As vacuum interrupters can quench the arc at current zero only, a delay of current zero results in longer arcing time with an extreme thermal stress on the interrupter.

The generator circuit breakers are tested according to IEEE C37.013 to withstand the high electrical, thermal and mechanical stress during the interruption of fault currents with a DC component up to130 %.

Vacuum interrupters are well suited to withstand very long arcing times due to their ability to interrupt even after the contact motion has ceased.

VAH has proven its ability to interrupt fault currents with a DC component up to 142%.

Specific voltage conditions

Generator circuits are characterized by a very low resistance and low stray capacitance. This system produces very high natural circuit frequencies resulting in extreme transient recovery voltages (TRV) with high rates of rise (RRRV).

The transient recovery voltage appears across the terminals after current interruption. It is a critical parameter for fault interruption by a circuit breaker; its characteristics (amplitude, rate of rise) can lead either to a successful current interruption or to a failure (called reignition or restrike). An important factor is how fast the TRV rises across the recovering gap after current zero (RRRV).

Schneider Electric VAH Generator Circuit Breakers are designed to clear high fault currents against the very fast RRRV values, in accordance with IEEE.

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Out-of-phase conditions

Schneider Electric VAH Generator Circuit Breakers can operate under out-of-phase conditions when the generator and power system voltages are not synchronous. IEEE requires that the generator circuit breaker can switch off under out-of-phase conditions (out-of-phase angle 90°) while the voltages across the open contacts can rise to 2.6 times the rated line-to-line voltage of the system. VAH has successfully confirmed this.

Robus traditional breaker-pole construction

The VAH circuit breaker design is based on traditional breaker-pole construction. The poles are mounted on a common base frame by means of robust cast resin insulators. The construction allows compact design with a minimum of solid insulation material.

By providing strong supports, the pole section holds the vacuum interrupter solidly, ensuring that it is completely free from the effects of external forces. The axial forces occurring during the making and breaking function act only on the contact system. This keeps the vacuum interrupter unstressed.

The simple circuit breaker construction permits the creation of easily customized solutions for special customer requirements.

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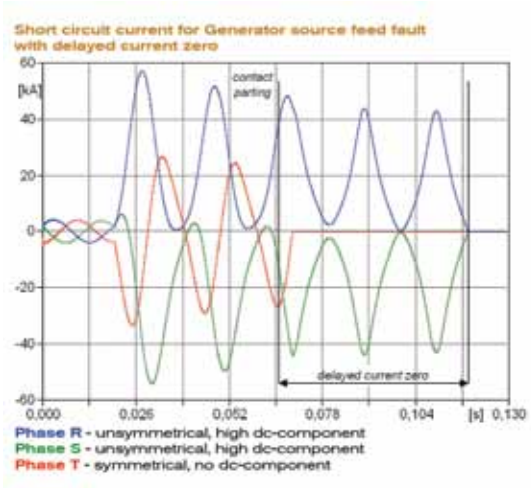

Phase R (blue) - unsymmetrical, high dc-component
Phase S (green) - unsymmetrical, high dc-component
Phase T (red) - symmetrical, no dc-component
Short circuit current for generator source feed fault with delayed current zero

Mechanical drive unit

The spring actuated drive and other ancillary mechanics are protected in the drive cabinet, which includes:

- Spring drive mechanism
- Electrical charging motor
- Auxilary switches
- Release coils
- Operation counter
- Mechanical operation and indication mechanism

Options and accesories

- Auxiliary switches: 16-pole or 20-pole
- Low voltage connection 64-pole
- Additional trip coil
- Indirect overcurrent trip (0.5 A or 1 A)
- Undervoltage trip
- Blocking magnet
- Key lock for push button ON and OFF
- Anti-pumping relay
- Transport trolley
- Manual operating crank for the spring
- charging mechanism

Rated maximum voltage	kV	15		17.5
Power frequency	Hz	50/60		50/60
Rated short-circuit breaking current	kArms	50		63
Rated short-time withstand current (duration)	kArms	50 (3s)		63 (3s)
Rated short-circuit making current	kAp	137		173
Rated continuous current	A	1,250 - 3,150	4,000 - 8,000*	3,150 - 5,000
Rated power frequency withstand voltage	kV	42		50
Rated full wave impulse withstand voltage	kV	95		110
Power range	MVA	up to 100		up to 200
Rated short-circuit duty cycle		CO-30 min-CO		CO-30 min-CO
Rated load currents & mechanical operation duty		O-3min-CO-3min-CO		O-3min-CO-3min-CO
SYSTEM-SOURCE SHORT-CIRCUIT INTERRUPTING CAPABILITY				
Symmetrical short-circuit current	kArms	50		63
Interrupting time		< 50 ms (3 cycles)		< 50 ms (3 cycles)
DC component		66%		75%
Peak recovery voltage (E2)	kVp	27.6		32.2
TRV rate of rise	kV/s	4		4.1
GENERATOR SOURCE INTERRUPTING CAPABILITY WITH DELAYED CURRENT ZERO				
Symmetrical short-circuit current	kV	31.5		37
DC component	kArms	142%		130%
Peak recovery voltage (E2)	kVp	27.6		32.2
TRV rate of rise	kV/s	1.6		1.8
OUT-OF-PHASE CURRENT SWITCHING CAPABILITY				
Duty voltage	kV	18.3		21.3
Symmetrical breaking current	kArms	20		31.5
Peak recovery voltage (E2)	kVp	39		45.5
TRV rate of rise	kV/s	3.3		4.1
DIMENSIONS (FIXED TYPE WITH BARRIER)**				
Pole center distance	mm	275		400
Height	mm	745**	1025**	970
Width	mm	835		1,100
Depth	mm	615	931	780
Weight	kg	200	500	500
Standard	IEEE C37.013			

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