The Importance of Transient Recovery Voltage

January 10, 1996

In PTB 10 there is some information about transient recovery voltage (TRV) and some data about the TRV values used by Powell in testing PowlVac® circuit breakers. I'll try to answer some additional recent questions about TRV in this PTB.

Q. Just what is transient recovery voltage:

A. As circuit breaker contacts part during the interrupting process, an arc is created between them. The contact-to-contact voltage is the arc voltage, typically about 600V in a 15kV circuit. When the current passes through zero, conduction ceases, and the contact-to-contact voltage moves toward the difference in system voltages on the two sides of the open circuit breaker. This change in voltage is the transient recovery voltage.

Q. How is TRV determined?

A. TRV is an inherent function of the parameters of a power system, and of the location and magnitude of the fault being interrupted. Since the circuit breaker is part of the system, it may have some minor effect on the TRV, but this effect is usually unimportant.

Q. Why should I care about TRV?

A. TRV withstand capability is a rating of a circuit breaker, just like continuous current, maximum voltage, and interrupting current. If the TRV withstand rating is exceeded by the system TRV, the circuit breaker may fail to perform properly.

Q. How do I know what my TRV will be?

A. This may take a computer-based system study. Computer programs designed for power system analysis can usually calculate TRV at selected points on the system.

Q. What TRV will my breaker withstand?

A. ANSI Standard C37.06 defines the requirements. The rating is stated in terms of a peak voltage, $E_2$, and a time to reach that voltage, $T_2$, at full rated short circuit current for a fault at the terminals of the breaker. For lower values of short circuit current, the voltage is higher and the timer is shorter. The curve between 0.0 and $E_2,T_2$ is defined as a "1-cosine" curve, shown visually in the figure below. For circuit breakers used in metal-clad switchgear, $E_2$ is required to be 1.88 times the breaker's rated maximum voltage. The present standard does not specify $T_2$, but a proposed revision lists values from 50µs for breakers rated 4.76kV to 125µs for breakers rated 38kV. Both $E_2$ and $T_2$ increase as the breaker's rated voltage increases. Breakers rated 121kV and above also use a different curve shape.
The Importance of Transient Recovery Voltage

Baldwin Bridger, P.E.
Technical Director