

[www.usa.siemens.com/techttopics](http://www.usa.siemens.com/techttopics)

# TechTopics No. 62

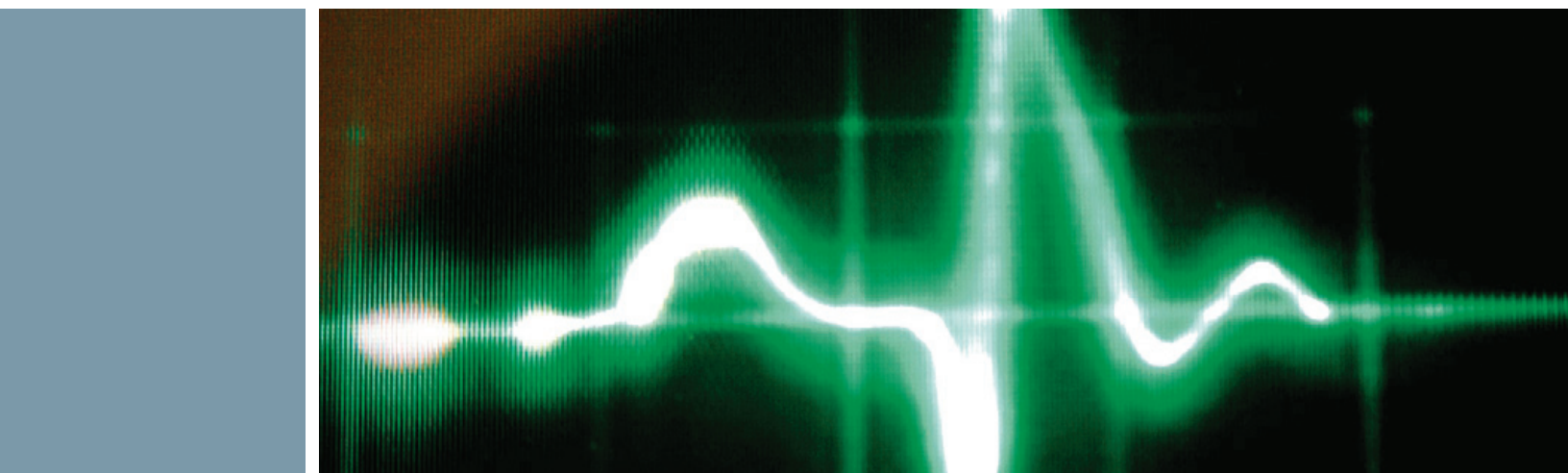
## A bit of history on circuit breaker standards

A number of issues of the TechTopics series have discussed changes in the ANSI/IEEE standards for switchgear that have occurred in recent years. One of the more controversial changes was the revision of the circuit breaker standards to reflect the new “constant kA” rating method, replacing the older “constant MVA” ratings basis. This was discussed in TechTopics No. 4 and again in TechTopics No. 23.

One of the major reasons that changes are made in the standards is that we learn more about the behavior of equipment under short-circuit conditions, and the level of instrumentation available for use during testing continues to make dramatic improvements. Not long ago, actual test short-circuit current was determined by manually drawing a current envelope on a paper oscillographic output chart that was several feet long produced during a test. The current itself was computed from careful measurements using a triangular scale with 50 gradations per inch, and a slide rule or a mechanical calculator. Thankfully, those days are behind us. Today, we get nearly real-time output of test values. Along with the increase in data accuracy and availability, we have been able to more precisely set up the laboratory test conditions, vary the parameters of the test in finer increments, and significantly increase the number of values monitored during tests.

Another significant reason for changes in the standards has been the movement toward globalization of standards. In the electrical field, we are somewhat “blessed” as amperes, volts, kilowatts, etc., have always been metric. We didn’t have to contend with differences in the basic units, but, even so, the methodology of circuit breaker ratings and testing has historically been quite different between the ANSI/IEEE standards and those of IEC.

It seems incredible, but this was recognized as a problem at least as early as 1951. In that year, AIEE (which merged with IRE to form IEEE in 1963) began to consider revision of the high-voltage circuit breaker standards to abandon the “total current basis of rating” and adopt a “symmetrical current basis of rating.” The goals were to simplify application of circuit breakers, harmonize with the ratings basis of IEC standards, and demonstrate a standard relationship between asymmetrical (total) interrupting capability and symmetrical interrupting capability. This effort resulted in the 1964 edition of the circuit breaker standards, including C37.04 (ratings basis), C37.09 (test methods), C37.010 (application guide) and C37.06 (preferred ratings values). The “collection” was revised in 1979 but without major change in the basic scheme. In 1987, the historic “MVA class” was finally dropped from the ratings tables. Yet, even today, many still commonly refer to “500 MVA circuit breakers.”



The underlying technology of the 1964 standards for medium-voltage circuit breakers was the air-magnetic circuit breaker for indoor (metal-clad) switchgear, and the bulk-oil circuit breaker for outdoor substation type equipment. Both technologies exhibited a “constant MVA” behavior, thus driving the ratings basis in the standard.

However, the technology moved forward with the vacuum circuit breaker coming to dominate the medium-voltage arena, and the gas circuit breaker (SF<sub>6</sub>) dominating for the higher voltages to the EHV range. These technologies exhibit a “constant kA” performance, which drove the ANSI/IEEE standards toward this ratings basis in the 1999 revisions. The “constant kA” basis of rating had been used in the IEC standards much earlier.

The high-voltage circuit breaker working groups are actively working to further harmonize with the IEC standards. Changes have been adopted in the characterization of TRV requirements with the adoption of IEEE C37.04b and C37.09b, plus IEEE C37.011-2005. In 2009, the revision of C37.06 was published, reflecting the new representation for TRV. The revision of C37.06 greatly expands the tables of circuit breaker ratings from the historic tables, which will be daunting to some.

Now that C37.06 has been revised, IEEE is poised to begin major revision work on the series of high-voltage circuit breaker standards. It is expected that the ratings tables in C37.06 will be merged into C37.04. Some discussion of merging C37.04, C37.06, C37.09 and C37.010 has taken place, but the result would be a very lengthy document, perhaps 200 pages or more. The challenge of navigating the IEEE ballot and approval process on a document of this length and complexity are formidable, suggesting that a split along historic lines may yet continue.

However, it seems clear that the process of harmonizing the ANSI/IEEE standards for medium- and high-voltage circuit breakers will continue in the next round of revisions.

Even for those engineers who are immersed in the standards on a daily basis, it is very hard to understand that the effort to harmonize with IEC is in its sixth decade and is still far from completion.

The information provided in this document contains merely general descriptions or characteristics of performance which in case of actual use do not always apply as described or which may change as a result of further development of the products. An obligation to provide the respective characteristics shall only exist if expressly agreed in the terms of contract.

All product designations may be trademarks or product names of Siemens AG or supplier companies whose use by third parties for their own purposes could violate the rights of the owners.

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

Subject to change without prior notice.  
Order No.: E50001-F710-A350-X-4A00  
All rights reserved.  
© 2012 Siemens Industry, Inc.

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

[www.usa.siemens.com/techttopics](http://www.usa.siemens.com/techttopics)