IEEE Standards Interpretations for IEEE Std C37.04™-1999, IEEE Std C37.06™-2000, and IEEE Std C37.09™-1999

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Interpretation Request #1
Topic: Rated Interrupting Time

What is the applicability of interrupting times determined by 50 Hz testing to applications of the high voltage circuit breaker when applied at 60Hz? Are the interrupting times obtained at 50 Hz 'converted' to a 60 Hz basis or added to the contact parting time 'raw'? Discussion:

- IEEE Std. C37.04-1999, 5.6 defines the rated interrupting time of a circuit breaker as the maximum permissible interval between the energizing of the trip circuit at rated control voltage and rated operating pressure for mechanical operation, and the interruption of the current in the main circuit in all poles. In discussing numerical values of interrupting time, IEEE Std C37.04-1999 uses 'cycles' as the unit of measure and clarifies that cycles are based on corresponding rated power frequency.
- IEEE Std. C37.06-2000 Table 1 provides for the preferred ratings of indoor circuit breakers including the rated interrupting time which is given in milliseconds.
- IEEE Std. C37.09-1999, 4.8.1.2 states: "If a circuit breaker contains interrupters that are not affected significantly by the di/dt, then tests performed at 50 Hz can be used to demonstrate the performance at 60 Hz and vice versa". For the purposes of this inquiry, let us assume that the interrupters under test fit this criterion.
- IEEE Std. C37.09-1999, 4.8.1.4 requires that in order to demonstrate the breaker is capable of meeting the requirements for the rated interrupting time, it must be shown that is can interrupt with the current zeros occurring in such relation to contact parting as to yield the longest arcing time. Further paragraphs define and discuss the arcing time in units of milliseconds.

High voltage circuit breakers which are tested at 50 Hz and subsequently applied at 60 Hz, or vice versa, may have their rated interrupting time defined by the sum of the contact parting time (at rated control voltage) and the maximum arcing time as determined during the design testing under C37.09 converted to the appropriate frequency base.

For example, for a circuit breaker with a 30 msec contact parting time which was tested at 50 Hz and determined to have a maximum arcing time of 22 msec. the following would be considered valid:

$$\frac{22\,m\sec}{20\,m\sec / cycle_{50Hz}} = 1.1\,cycles \bullet \frac{16.7\,m\sec}{cycle_{60Hz}} = 18.4\,m\sec\ arcing\ time$$

Equation 1: Conversion of Interrupting Time from 50 Hz to 60 Hz basis

If the above conversion is considered technically valid, then the breaker cited could be rated as a 50 msec ('3 cycle') breaker. If not accepted, then the next 'preferred' value for rated interrupting time would be 83 msec ('5 cycles').

Interpretation Response
The standards do not specifically address the conversion of rated interrupting timing test results from one power frequency to another at this time. This matter is being referred to the sponsor for possible action during the next revision.