Momentary Rating and Construction of Bus in Metal-Enclosed Switchgear

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The bus in metal-enclosed power switchgear is required by ANSI standards to have a momentary current rating equivalent to the momentary rating of the circuit breaker, switch or fuse used in the particular switchgear equipment. In the case of low voltage switchgear, where the circuit breaker momentary rating may vary with the breaker frame size, a particular assembly is required to have the momentary rating of the smallest frame size of circuit breaker used in the assembly. Thus, if the circuit breakers or other switching devices are properly applied, the equipment momentary will match both the needs of the system and the rating of the switching device. Where bus duct is used in conjunction with metal-enclosed switchgear, the bus duct momentary rating should match that of the switchgear.

Momentary ratings are normally proved by high current testing. The bus must withstand the test without any permanent deformation of the bus bar, or if there is permanent deformation, it must not be sufficient to prevent the equipment from passing its standard dielectric tests (hipot and impulse). There also must be no breakage of the bus supports.

There are a number of design variables that enter into the ability of the bus structure to withstand a momentary current. The forces involved are quite high. For a bus consisting of one ¼" x 4" bar per phase, on 6" phase centers, a 50 kA current creates a force on each bus bar of nearly 17,000 pounds per foot of length. Both the bus supports and the bars themselves must withstand this force. The force is directly proportional to the square of the current and inversely proportional to the phase spacing, so moving the bus bars apart decreases the force. The force is also affected to a small degree by the dimensions and shape of the bus bars.

The ability of the bars to withstand the force created by the momentary current is a function of the size, shape, and material of the bar and the arrangement of the bars with respect to each other, i.e., flat-to-flat or edge-to-edge. In mechanical terms, these determine the section modulus of the bars in the phase-to-phase direction. The deflection of the bars is also affected by the length of the span, or the distance between supports. The strength of the bus support structure is determined by the material and configuration of the supports and the distance between them.

The standards require test to demonstrate the momentary rating of the bus, and most bus structures within switchgear are somewhat complex and not subject to easy analysis, so we seldom use calculations for the design of bus structures. However, for relatively simple bus configurations, such as bus duct, it may be easy to modify a design based on previous test data. For instance, if phases are spread apart further than they were in the tested sample, the allowable increase in spacing between supports can be easily calculated.

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