MP-15 : COMPARISON OF UNBALANCE CALCULATION METHODS

The following is a comparison of common unbalance calculation methods.

With the use of the latest DSP technology, the MPS uses a True-Sequence component calculation for unbalance. MPS unbalance is the ratio of the negative sequence component (I_2) to positive sequence component (I_1). Both magnitude and phase are part of the unbalance calculation. As shown, the I_2/I_1 method is less sensitive to "in-phase" unbalance and more sensitive to "out-of-phase" unbalance. In addition, the calculation is valid for all current levels.

For the comparison, a three-phase system is assumed with currents phased at 120 degrees and FLA = 100 A.

Ia	Ib	Ib	I_{ave}	MPS I_2/I_1	$(I_{max} - I_{min})/I_{fla}$	$(I_{ave} - I_{min})/I_{ave}$	$(I_{max} - I_{min})/I_{max}$
78 A	94 A	93 A	88.3 A	0.06	0.16	0.12	0.17
62 A	78 A	77 A	72.3 A	0.07	0.15	0.14	0.20
46 A	62 A	61 A	56.3 A	0.09	0.16	0.18	0.26
31 A	46 A	45 A	40.6 A	0.12	0.15	0.24	0.33
15 A	31 A	30 A	25.3 A	0.19	0.16	0.41	0.52

The unbalance calculation is sensitive to phase distortion, which results in motor heating. In the following example, the phase is changed and clearly shows that a motor protection relay using I_2/I_1, such as the MPS, will detect a problem where all other methods will not. For the test, the current magnitude was fixed at 93 A in all three phases.

Pha to Phb	Phb to Phc	Phc to Pha	MPS I_2/I_1	All Others
120°	120°	120°	0.00	0
130°	100°	130°	0.11	0

The I_2/I_1 calculation method has been tested with across-the-line, reduce-voltage starters using both current and tachometer feedback, and synchronous machines where the no-load currents are in the range of 5 to 10 % FLA.